RESTRICTED—Security Information

TM 9-6109

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

ORDNANCE MAINTENANCE

PLOTTING BOARDS M5 AND M5A2 SOUND-RANGING PLOTTING BOARDS M1 AND M1A1 AND SOUND-RANGING WIND CORRECTOR M1

DEPARTMENT OF THE ARMY • NOVEMBER 1953

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TECHNICAL MANUAL
No. 9–6109

DEPARTMENT OF THE ARMY
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ORDNANCE MAINTENANCE: PLOTTING BOARDS M5 AND M5A2; SOUND-RANGING PLOTTING BOARDS M1 AND M1A1; AND SOUND-RANGING WIND CORRECTOR M1

* This manual supersedes TM 9–1569, 21 May 1942.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual is published for the information and guidance of personnel responsible for field and depot maintenance of sound-ranging plotting boards M1 and M1A1 (fig. 1), sound-ranging wind corrector M1 (fig. 2), and plotting boards M5 and M5A2 (fig. 3). This manual does not contain information that is intended primarily for the using organization, since such information is available to ordnance maintenance personnel in the pertinent operator's technical manuals.

b. This manual contains a description of and procedures for inspection, disassembly, repair, rebuild, and assembly of the sound-ranging plotting boards M1 and M1A1, the sound-ranging wind corrector M1, and the plotting boards M5 and M5A2.

c. The appendix contains a list of current references, including supply manuals, technical manuals, and other available publications applicable to the sound-ranging plotting boards M1 and M1A1, the sound-ranging wind corrector M1, and the plotting boards M5 and M5A2.

d. Operation, lubrication, and all maintenance operations allocated to using organizations in performing maintenance work within their scope for the sound-ranging plotting boards M1 and M1A1, the sound-ranging wind corrector M1, and the plotting boards M5 and M5A2 are contained in TM 9–575.

e. This manual differs from TM 9–1569, 21 May 1942, as indicated in (1) and (2) below.

(1) Adds information on: sound-ranging plotting board M1A1 and plotting board M5A2.

(2) Revises information on: sound-ranging plotting board M1, sound-ranging wind corrector M1, and plotting board M5.

2. Field and Depot Maintenance Allocation

The publication of instructions for complete disassembly and rebuild is not to be construed as authority for the performance by field maintenance units of those functions which are restricted to depots and arsenals. In general, the prescribed maintenance re-

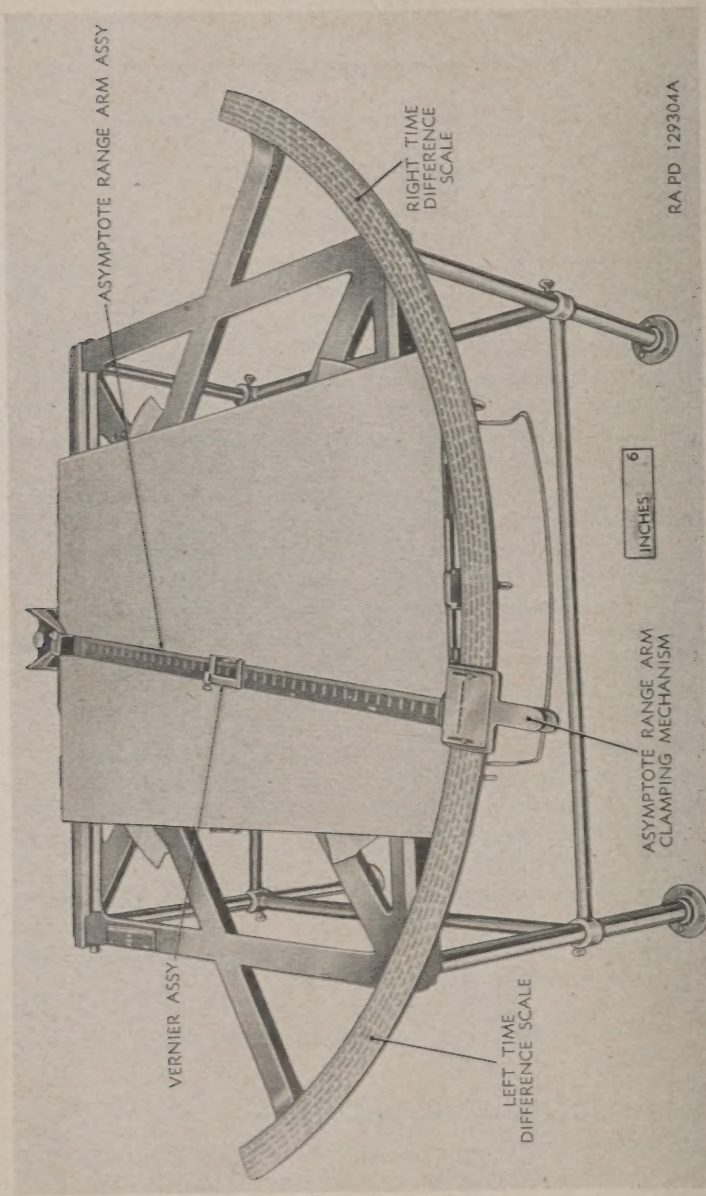


Figure 1. Sound-ranging plotting board M1 or M1A1—front view.

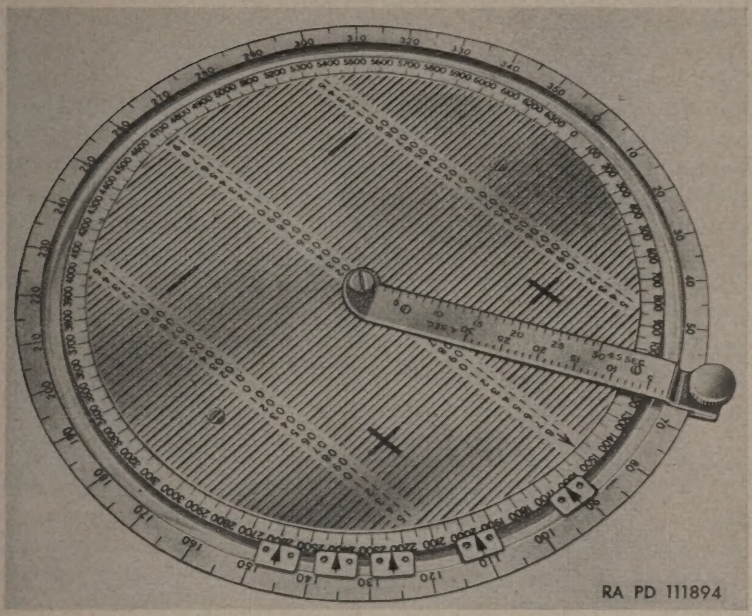


Figure 2. Sound-ranging wind corrector M1.

Figure 3. Plotting board M5 or M5A2—M5 shown.

sponsibilities will apply as reflected in the allocation of maintenance parts and tools listed in the appropriate columns of Department of the Army Supply Manuals ORD 8 SNL F–154 (sound-ranging plotting boards M1 and M1A1), ORD 8 SNL F–153 (sound-ranging wind corrector M1), ORD 8 SNL F–233 (plotting boards M5 and M5A2), and ORD 6 SNL F–272. Instructions for depot maintenance are to be used by maintenance companies in the field only when the tactical situation makes the repair functions imperative. Provisions of parts listed in the depot stock guide column of ORD 8 SNL F–154, ORD 8 SNL F–153, and ORD 8 SNL F–233 will be made to field maintenance only when the emergency nature of the maintenance to be performed has been certified by a responsible officer of the requisitioning organization.

3. Forms, Records, and Reports

a. General. Responsibility for the proper execution of forms, records, and reports rests upon the officers of all units maintaining the sound-ranging plotting boards M1 and M1A1, the sound-ranging wind corrector M1, and the plotting boards M5 and M5A2. However, the value of accurate records must be fully appreciated by all persons responsible for their compilation, maintenance, and use. Records, reports, and authorized forms are normally utilized to indicate the type, quantity, and condition of materiel to be inspected, to be repaired, or to be used in repair. Properly executed forms convey authorization and serve as records for repair or replacement of materiel in the hands of troops and for delivery of materiel requiring further repair to ordnance shops in arsenals, depots, etc. The forms, records, and reports establish the work required, the progress of the work within the shops, and the status of the materiel upon completion of its repair.

b. Authorized Forms. The forms generally applicable to units maintaining the sound-ranging plotting boards M1 and M1A1, the sound-ranging wind corrector M1, and the plotting boards M5 and M5A2 are listed in the appendix. For a current and complete listing of all forms, see current SR 310–20–6. For instructions on the use of these forms, refer to FM 9–10. Additional forms applicable to the using personnel are listed in TM 9–575.

c. Field Report of Accidents. The reports necessary to comply with the requirements of the Army safety program are prescribed in detail in SR 385–10–40. These reports are required wherever accidents involving injury to personnel or damage to materiel occur.

d. Report of Unsatisfactory Equipment or Materials. Any suggestions for improvement in design and maintenance of equipment and spare parts, safety and efficiency of operation, or pertaining to

the application of prescribed lubricants, and/or preserving materials, or technical inaccuracies noted in Department of the Army publications, will be reported through technical channels, as prescribed in SR 700–45–5, to the Chief of Ordnance, Washington 25, D. C., ATTN: ORDFM, using DA Form 468, Unsatisfactory Equipment Report. Such suggestions are encouraged so that other organizations may benefit.

Note. Do not report all failures that occur. Report only repeated or recurrent failures which indicate unsatisfactory design or material. See also SR 700–45–5 and printed instructions on DA Form 468.

Section II. DESCRIPTION AND DATA

4. Tabulated Data

Data pertaining to the sound-ranging plotting boards M1 and M1A1, the sound-ranging wind corrector M1, and the plotting boards M5 and M5A2 are listed in table I.

Table I. Tabulated Data

	Sound-ranging plotting board M1	Sound-ranging plotting board M1A1	Sound-ranging wind corrector M1	Plotting board M5	Plotting board M5A2
Range	0–20,000 yd	0–25,000 yd		Unlimited	Unlimited
Standard map scale.	1/20,000	1/25,000		1/20,000	1/25,000
Time-difference scale	60–0–60 deg	60–0–60 deg			
Azimuth scale			0–6400 mils and 0–360 deg	0–6400 mils	0–6400 mils
Subbase length (sound).	4.0, 4.5, 5.0, 5.5 sec	4.0, 4.5, 5.0, 5.5 sec			
Microphone station radius	120 deg	120 deg			
Angle of swing, asymptote range arm assembly	120 deg	120 deg			
Length	50 inches	56 inches	10-inch rad (aprx)	45 inches (aprx)	45 inches (aprx)

	Sound-ranging plotting board M1	Sound-ranging plotting board M1A1	Sound-ranging wind corrector M1	Plotting board M5	Plotting board M5A2
Width	72 inches	72 inches		40¾ inches (aprx)	40¾ inches (aprx)
Height	36 inches	36 inches	⅝ in	34⅞ inches (aprx)	34⅞ inches (aprx)
Weight	250 lb	250 lb	1.75 lb	276 lb	276 lb

5. Functional Description of Sound-Ranging Plotting Boards M1 and M1A1

a. General. The sound-ranging plotting boards are used for determining the location of artillery weapons by plotting the difference in time for the sound of the report to reach each of several microphone stations. The sound-ranging plotting boards M1 and M1A1 (fig. 4) consist principally of the following components: a frame assembly supported by four braced legs, a straight- (or curved-) base carriage assembly, a straight (or curved) platen assembly, and an asymptote arm assembly.

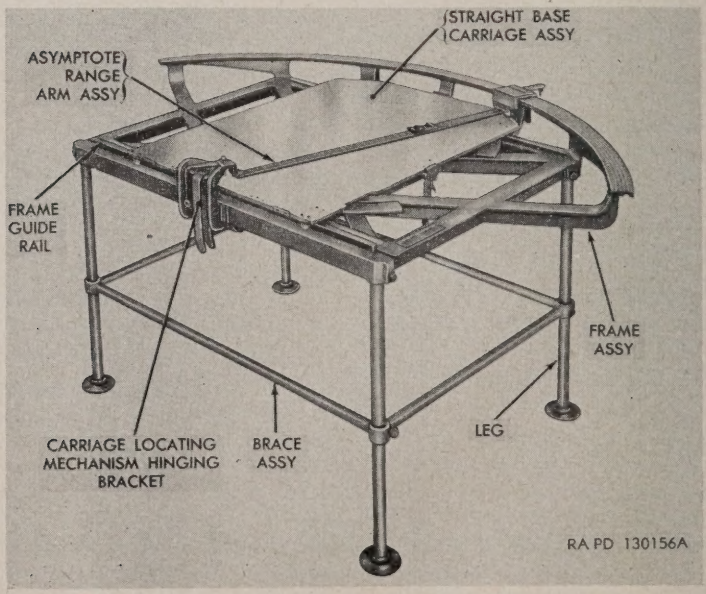


Figure 4. Sound-ranging plotting board M1 or M1A1—components.

b. Frame Assembly. The frame assembly of each sound-ranging plotting board is a casting with a raised horizontal arc for supporting the time-difference scale. The frame assembly is mounted on four braced legs and supports the remaining components of the plotting board. The carriage assembly rolls on the machined upper surfaces of the frame assembly by means of the carriage roller assemblies. A pivot spindle screwed into any one of three sockets in the frame assembly serves as the center of rotation of the curved-base carriage assembly. When the straight-base carriage assembly is used the spindle is removed and the carriage assembly rolls laterally, following the guide rail at the rear of the frame. A carriage locating plunger bracket, mounted on the rear of the frame at the center, contains the carriage locating plunger. This bracket provides a rear tripping lever for raising and lowering the plunger.

c. Straight-Base Carriage Assembly. The straight-base carriage assembly is used when the microphone stations are in a straight line. It includes a lower plate with rollers, the plotting plate, and platens. Six vertical rollers, attached to the side of the carriage, provide support and a means of moving the carriage on the frame. Four platens are furnished—one for each subbase length.

d. Curved-Base Carriage Assembly.

(1) The curved-base carriage assembly (fig. 5) is used when the microphone stations are equally spaced along an arc of a circle, the center of which coincides approximately with the center of the area to be plotted.

(2) It includes a lower plate with spindle, a plotting plate, and platens. This carriage pivots about a spindle, attached to the frame and is provided with an adapter containing three radial holes so that it can be mounted to swing in an arc, the radius of which corresponds to the radius of the arc of the microphone stations. The curved-base carriage assembly can be mounted to swing in an arc, the radius of which corresponds, in miniature scale, to the radius of the arc on which the microphone stations are located. This is an arc of 25-, 30-, or 35-sound-second radius.

(3) The curved-base carriage assembly is locked in any one of five positions in the same manner as the straight-base carriage assembly. It can also be released by means of the front or rear tripping levers. Rotation of the curved-base carriage assembly is limited by two stops riveted to the extremities of the rear circular machined track of the frame assembly.

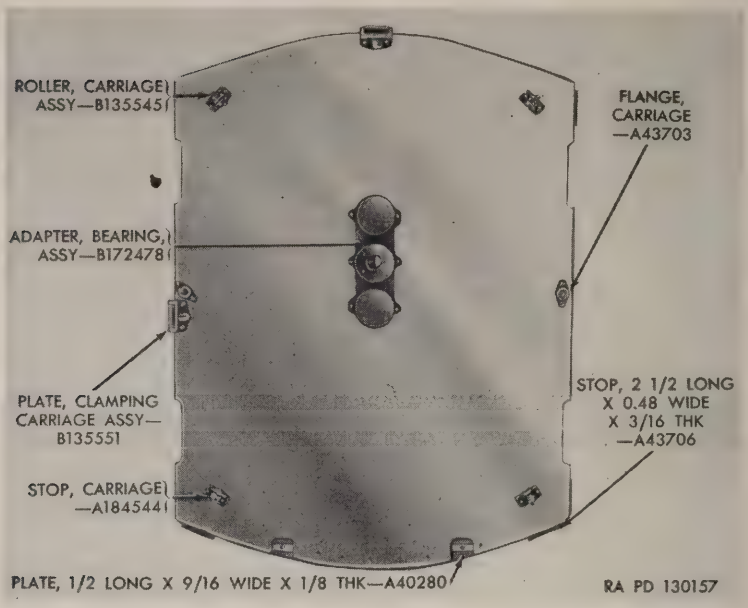


Figure 5. Curved-base carriage assembly—C79083, sound-ranging plotting board M1 or M1A1—bottom view.

e. Platen Assembly (Straight-Base). The platen assemblies (fig. 6) are steel strips approximately equal in length. Four straight-base platen assemblies are supplied, corresponding to the four subbase lengths of 4.0, 4.5, 5.0, and 5.5 sound-seconds. Each platen assembly has seven holes tapered to receive the end of the carriage locating plunger. The appropriate platen assembly is screwed into position under the rear edge of the carriage assembly. (Four platen plugs are supplied for use with the straight-base platen.) The carriage assembly, therefore, can be moved only when the plunger is lifted out of the tapered hole. It is again locked in position when the plunger is dropped into another hole in the platen. The tapered holes in the platen assemblies are so located on a straight line that when the two outside holes or the holes nearest the center hole are plugged, the remaining five holes are equally spaced. When the two outside holes are plugged, the sound ranging plotting board is used to ascertain the location of sound sources more than 20,000 yards distant. When the two holes nearest the center hole are plugged, the plotting board is used to locate sound sources less than 20,000 yards distant.

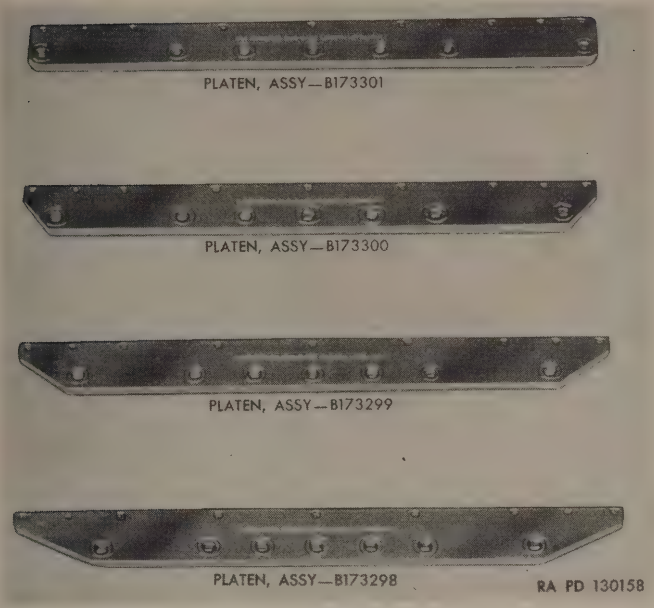


Figure 6. Straight-base platen assemblies—sound-ranging plotting board M1 and M1A1.

f. Platen Assembly (Curved-Base).

(1) The curved-base carriage assembly is supplied with eight platen assemblies (fig. 7). They are steel strips about the same length as the platen assemblies used for the straight-base carriage assemblies. The lower edge is curved in an arc that corresponds proportionally to the arc on which the microphone stations are located. Along the curved edge of the platen assembly are five tapered holes, equally spaced. The eight platen assemblies for the curved-base carriage are divided as follows:

25-sound-second radius
- 1 platen assembly with 4-second subbase
- 1 platen assembly with 4½-second subbase

30-sound-second radius
- 1 platen assembly with 4-second subbase
- 1 platen assembly with 4½-second subbase
- 1 platen assembly with 5-second subbase

35-sound-second radius
- 1 platen assembly with 4½-second subbase
- 1 platen assembly with 5-second subbase
- 1 platen assembly with 5½-second subbase

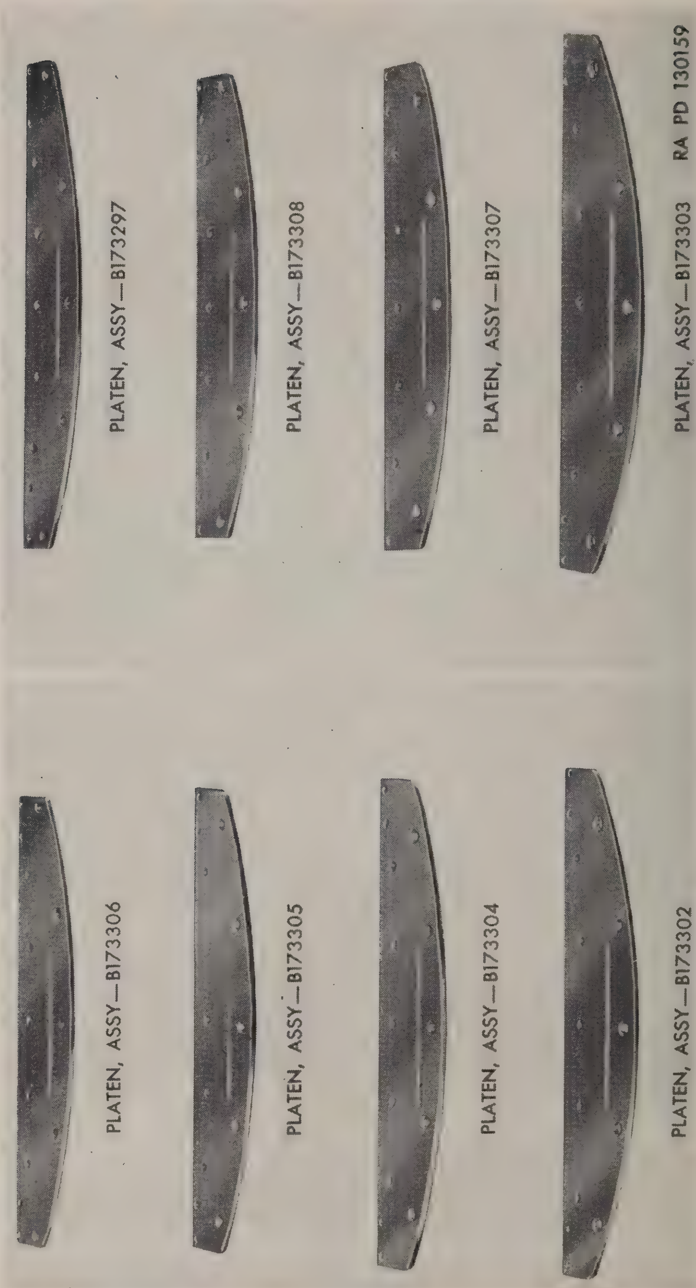


Figure 7. Curved-base platen assemblies—sound-ranging plotting boards M1 and M1A1.

(2) The three standard sound-second radii, 25, 30, and 35, correspond to the three radial bearings or sockets of the adapter into which the spindle is inserted. When the 25-sound-second radius is used, for example, the spindle is screwed into the socket in the frame nearest the carriage locating plunger bracket. The protruding end of the spindle fits into the corresponding bearing of the adapter. For the 30- and 35-sound-second radii, the spindle is screwed into the middle and forward socket, respectively, and inserted into the corresponding bearing in the adapter.

g. Asymptote Range Arm Assembly (fig. 4).

(1) The asymptote range arm assembly is used to plot the asymptote of an observed sound upon the plotting plate, which is clipped to the upper surface of the carriage assembly. The arm assembly has a beveled edge for plotting the lines and a scale that is graduated from 1,000 to 20,000 yards for the sound-ranging plotting board M1 and from 1,000 to 25,000 yards for the sound-ranging plotting board M1A1.

(2) A vernier assembly (fig. 1) is clamped to the arm assembly. Use of the vernier increases the plotting accuracy.

(3) The arm assembly pivots about the microphone center assembly on the bracket and can be swung through a horizontal arc of 120 degrees. On the free end of this arm is a clamping mechanism and index. An adjustable cover conceals all the scales on the time-difference scale except the one being used. By pressing the clamping lever the clamp is released and the arm can be rotated to any desired reading.

6. Difference Between Models

a. The asymptote-range-arm scale of the sound-ranging plotting board M1 is graduated from 1,000 to 20,000 yards at a scale of $\frac{1}{20,000}$. The sound-ranging plotting board M1 plots at a standard map scale of $\frac{1}{20,000}$ yards.

b. The asymptote-range-arm scale of the sound-ranging plotting board M1A1 is graduated from 1,000 to 25,000 yards at a scale of $\frac{1}{25,000}$, and the board plots at a standard map scale of $\frac{1}{25,000}$ yards.

7. General Theory of Operation for the Sound-Ranging Plotting Boards M1 and M1A1

A sonic disturbance, caused by the discharge of a gun, is propagated in all directions as a wave traveling at the speed of sound,

which is 360 to 380 yards per second at average temperature and humidity. In still air, the same sound will arrive simultaneously at two points equidistant from the source of the sound, that is, when the sound source lies along the perpendicular bisector of the line connecting the two points. The arrival time at the points of observation will differ for a sound source in any other position. This difference increases as the sound source moves away from the perpendicular bisector, thus providing a measure of the angular distance of the sound source from this line. If two microphone stations are placed some distance apart and the difference in arrival time is recorded at each microphone, the direction of a line that passes close to the origin of the sound may be determined. Theoretically, this same line is tangent at infinity to a hyperbola that passes through the origin and is, therefore, called the asymptote.

8. Purpose of the Sound-Ranging Wind Corrector M1

The sound-ranging wind corrector M1 (fig. 2) is issued with the sound-ranging plotting boards M1 and M1A1 to solve the wind corrections graphically, that is, to determine the time-difference increment in value and sign.

9. Functional Description of the Sound-Ranging Wind Corrector M1

a. General. The wind corrector (fig. 8) consists of a correction-scale disk carrying a correction scale, an azimuth scale assembly, and a wind-velocity-scale arm assembly.

b. Correction-Scale Disk. The correction-scale disk (fig. 8) is an aluminum disk that serves as the base for the wind corrector. Upon it are mounted the correction scale and the azimuth scale assembly, the latter fitting into a recess on the upper circumference of the disk. The wind-velocity-scale arm assembly pivots about a screw centrally located on the disk.

c. Correction Scale. The correction scale (fig. 8) is mounted in a fixed position on the correction-scale disk by two flat-head screws. On the upper surface of the disk, engraved markings divide the scale into four quadrants, two positive and two negative. It is subdivided by means of parallel lines 0.005 seconds apart. The lines are marked at 0.01-second intervals. The correction scale also bears an index that is positioned at a point on the inner azimuth scale to orient the subbase scale.

d. Azimuth Scale Assembly. The azimuth scale (fig. 8) contains an inner scale graduated in mils from 0 to 6,400 to indicate the azimuth of the subbase. An outer scale graduated in degrees from

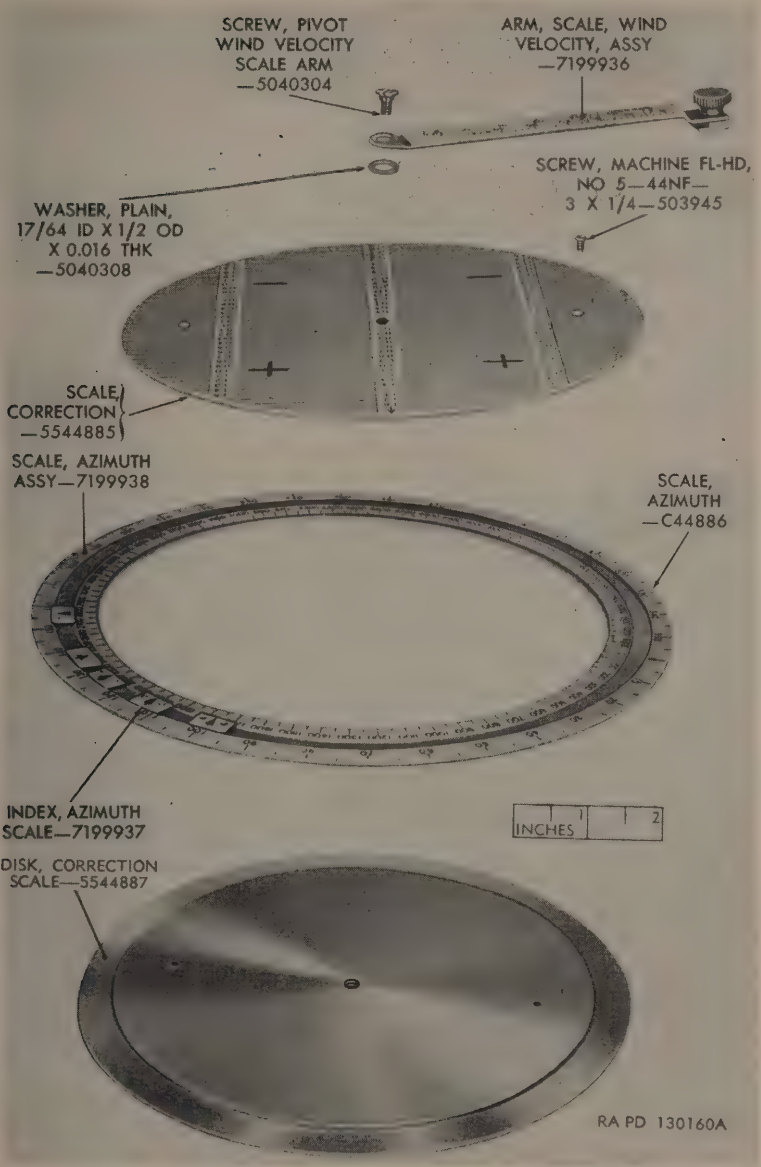


Figure 8. Sound-ranging wind corrector M1—components.

0 to 360 degrees determines the azimuth of the wind (direction from north). Five azimuth scale indexes are mounted in the annular groove between the outer and inner scales of the azimuth scale. The indexes are free to slide and are used as markers to represent the different subbases.

e. Wind-Velocity-Scale Arm Assembly. The wind-velocity scale arm assembly (fig. 8) pivots about a central screw on the correction-scale disk. The arm is used to set the azimuth of the wind against the outer scale and to read the wind correction from the correction scale. A clamp and screw at the free end permit locking the arm in any position. The wind-velocity scale is attached to the upper surface of the wind-velocity arm with two screws and bears four scales along its edge, graduated for four different subbase lengths: 4.0, 4.5, 5.0, and 5.5 seconds. The scale is reversible, two subbase lengths being on either side.

10. Purpose of the Plotting Boards M5 and M5A2

The plotting boards M5 and M5A2 are used to determine the location of artillery weapons by plotting the line of azimuth of the flash or smoke from the weapons as reported by two or more observation posts.

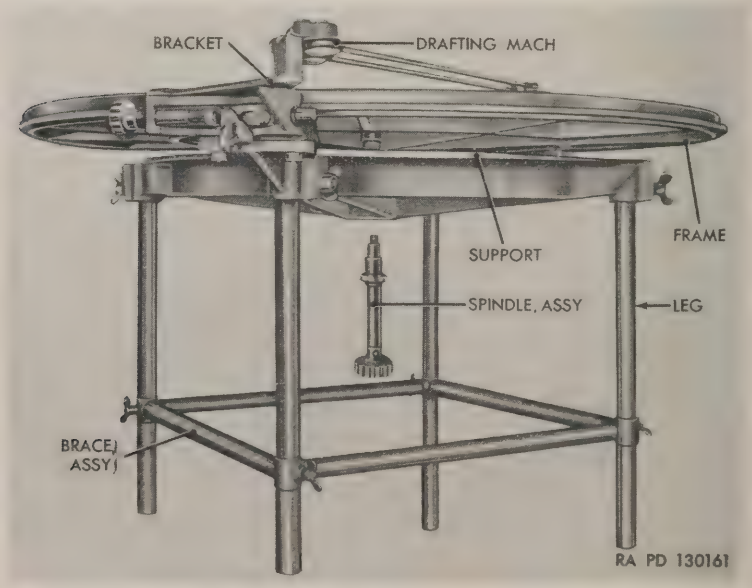


Figure 9. Plotting board M5 or M5A2—side view.

11. Functional Description of the Plotting Boards M5 and M5A2

a. General. Each plotting board (fig. 9) consists of a rotating frame, a drafting machine with a graduated straightedge scale attached, a bracket, and a support with a brace assembly and four legs.

b. Frame. The frame is an aluminum alloy casting that rotates around a central spindle assembly in the support. The grid disk, used for plotting, is screwed directly into the upper surface of the frame. The upper surface of the frame is graduated around its perimeter with 10-mil graduations from 0 to 6,400, numbered every 100 mils. The frame rolls on four bearings that are attached to the support.

c. Drafting Machine. The drafting machine is attached to the plotting board through a bracket screwed to the support. A straightedge scale pivoted to the cross bar of the drafting machine enables plot lines to be drawn in any direction and at any position upon the grid disk. The scale has one beveled edge to match the grid. The straightedge scale for the plotting board M5 is divided into 20 major graduations, one of which further subdivides the grid blocks into 10 increments. The straightedge scale for the plotting board M5A2 is divided into 24 major graduations.

d. Bracket. The bracket is fastened to the frame and secures one end of the drafting machine. To permit accurate settings of the announced azimuth and to keep the grid disk from rotating while plotting, a clamping shoe steadies the grid disk to the bracket. A gradual adjustment of the position of the frame can be made by turning the screw assembly in the bracket. The clamping shoe that grips the rim of the frame can be released by pressing the clamping lever.

e. Support. The support fastens the four legs in sockets on the underside of the support casting. The spindle assembly, which rotates on a ball bearing located in the center of the support casting, is also housed on the support. Thumbscrews, locked by set screws, hold the legs firmly in the sockets of the support.

12. Differences Between Models

The plotting boards M5 and M5A2 are identical except for the range scales and plotting disks. The M5 plots at a standard map scale of $\frac{1}{20,000}$ yards. The M5A2 plots at a standard map scale of $\frac{1}{25,000}$ meters. The scales are graduated to match the grid.

13. General Theory of Operation for the Plotting Boards M5 and M5A2

The plotting boards M5 and M5A2 incorporate the fundamental trigonometric sine law of oblique triangles. In practice, the azi-

muth of the flash or smoke as observed from two or more observation posts are known and are represented upon a grid in terms of their X and Y coordinates. The point of the azimuth intersections plotted through the observation posts will locate, to a miniature scale, the source of the flash. When five or more observation posts are used and the reported azimuths do not intersect at a point, the plot lines form what is called the "polygon of error." The source of the flash is taken as the locus of the perpendicular bisectors of the lines forming the "polygon of error."

CHAPTER 2

PARTS, SPECIAL TOOLS, AND EQUIPMENT FOR FIELD AND DEPOT MAINTENANCE

14. General

Tools and equipment and maintenance parts over and above those available to the using organization are supplied to ordnance field maintenance units and depot shops for maintaining, repairing, and for rebuilding the sound-ranging plotting boards M1 and M1A1, the sound-ranging wind corrector M1, and the plotting boards M5 to M5A2.

15. Parts

Maintenance parts are listed in Department of the Army Supply Manuals ORD 8 SNL's F–153, F–154, and F–233, which are the authority for requisitioning replacements. Parts not listed in an ORD 8 manual, but required by depot shops in rebuild operations, may be requisitioned from the listing in the corresponding ORD 9 manual and will be supplied if available, when the need is substantiated. Requisitions for ORD 9 parts will contain a complete justification of requirements.

16. Common Tools and Equipment

Standard and commonly used tools and equipment having general application are authorized for issue by T/A and T/O&E. They are not specifically identified in this manual.

17. Special Tool

The special tool in table II is listed in Department of the Army Supply Manual ORD 6 SNL F–272. This tabulation contains the only special tool necessary to perform the operations described in this manual, is included for information only, and is not to be used as a basis for requisitions.

Table II. Special Tool for Field and Depot Maintenance

Item	Stock number	References		Use
		Fig	Par	
WRENCH, combination, open end spanner	41–W–867–812	57	98, 108	General purpose wrench for use with plotting boards M5 and M5A2.

CHAPTER 3

INSPECTION

Section I. GENERAL

18. Scope

This chapter provides specific instructions for the technical inspections by ordnance maintenance personnel of the sound-ranging plotting boards M1 and M1A1, the sound-ranging wind corrector M1, and plotting boards M5 and M5A2, either in the hands of troops or when received for repair in ordnance shops. It also defines the in-process inspection of materiel during repair and rebuild and the final inspection after repair and rebuild has been completed. Trouble shooting information is incorporated wherever applicable as a normal phase of inspection.

19. Purpose of Inspection

Inspection is primarily for the purpose of (1) determining the condition of an item, i.e., serviceable or unserviceable, (2) recognizing conditions that would cause failure, (3) assuring proper application of maintenance policies at prescribed levels, and (4) determining the ability of a unit to accomplish its maintenance and supply missions.

20. Categories of Technical Inspections

In general, there are five categories of inspection performed by ordnance maintenance personnel as described in *a* through *e* below.

a. Overall Inspection. This is a periodic overall inspection performed on all materiel in the hands of troops or on materiel received for repair in field or depot maintenance shops. Upon completion of an inspection for serviceability, materiel will be declared either serviceable or unserviceable. This inspection may be limited in scope, such as an inspection of materiel in the hands of troops, or detailed in scope, such as an ordnance shop inspection. Detailed procedures are presented in section II.

b. Pre-Embarkation Inspection. This inspection is conducted on materiel in the hands of troops alerted for overseas duty to insure that such materiel will not become unserviceable or worn out in a relatively short time. It prescribes a higher percentage of remaining usable life in serviceable materiel to meet a specific need beyond minimum serviceability.

c. In-Process Inspection. These are inspections performed by the repair technician and/or floor inspector in the process of repairing or rebuilding the materiel and its components. This is to insure that all parts conform to prescribed standards, that the workmanship is in accordance with approved methods and procedures, and that deficiencies not disclosed by the technical inspection are found and corrected. Detailed instructions are contained in chapter 4.

d. Final Inspection. This is an acceptance inspection performed by a final inspector, after repair and rebuild has been completed, to insure that the materiel is acceptable according to established standards. Detailed instructions are contained in chapter 5.

e. Spot-Check Inspection. This is a periodic overall inspection performed on only a percentage of the materiel in each unit to determine the adequacy and effectiveness of organizational and field maintenance.

21. Classification of Materiel

All ordnance materiel after inspection is classified as described in *a* and *b* below.

a. Serviceable. Serviceable property consists of all new or used supplies that are in condition for issue for the purpose intended and all supplies that can be placed in such condition through preissue tests or inspections, in-storage deprocessing, installation of accessories, correction of minor deficiencies that have developed since the item was last classified as serviceable, application of modification work orders for which parts are available, or assembly of available components.

b. Unserviceable. Unserviceable property consists of all supplies that are not serviceable (*a* above). The definition of unserviceable property is further broken down into the following subclassification: property that is unserviceable but economically repairable, property that is unserviceable and not economically repairable.

Section II. TECHNICAL INSPECTION

22. General

This section provides specific instructions for the technical inspection by ordnance maintenance personnel of the sound-ranging plotting boards M1 and M1A1, the sound-ranging wind corrector M1, and plotting boards M5 and M5A2 in the hands of troops. Also, this section amplifies the general instructions contained in TM 9–1100 so far as the instructions pertain to inspection of plotting boards for field artillery. The inspection procedures and

standards listed in paragraph 23 *a* though *d* apply to all plotting boards for field artillery. Personnel making these inspections will acquaint themselves with the malfunctions indicated in paragraph 23 *b*, *c*, and *d*, which are the most common deficiencies of the sound-ranging plotting boards M1 and M1A1, sound-ranging wind corrector M1, and plotting boards M5 and M5A2. In general, if the plotting board or wind corrector is complete and performs its intended function properly; if all modification work orders classified as urgent have been completed; and all defects as disclosed by the inspection have been corrected; the plotting boards and/or wind corrector may be considered serviceable.

23. Inspection of Sound-Ranging Plotting Boards M1 and M1A1, Sound-Ranging Wind Corrector M1, and Plotting Boards M5 and M5A2 in the Hands of Troops

a. Inspection of Mechanical Parts.

(1) *Completeness.* Inspect the sound-ranging plotting board M1 or M1A1, plotting board M5 or M5A2, or sound-ranging wind corrector M1 for the presence of all visible component assemblies as well as for scales, name plates, nuts, and screws. Special attention must be given the small headless set screws that secure adjusting screws and thumbscrews. A missing or loose set screw will effect an insecure adjustment.

(2) *Appearance.* The appearance of any one of the plotting boards for field artillery will indicate its general condition and will reflect the type of treatment it has received. The inspector will make a visual inspection of the materiel to make certain that exterior surfaces are free of chipping, rust, dents, breaks, and foreign matter that will interfere with smooth operation or the legibility of scales.

(3) *Functioning of mechanical components.* Mechanical components must operate smoothly without binding or rough motion. Parts must be free from grit and properly lubricated. See performance tests, *b*, *c*, and *d* below.

(4) *Modification work orders.* All urgent modification work orders must have been applied. Check on application of all authorized modifications to see that no unauthorized alterations have been made or that no work beyond the authorized scope of the unit is being attempted. Refer to SR 310–20–4 for a listing of modification work orders.

(5) *Forms and reports.* Authorized forms and reports for technical inspection are prescribed in TM 9–1100. For

additional authorized forms and reports for field and depot maintenance, refer to the appendix of this manual.

(6) *Name plates, scales, and indexes.* Inspect scale numbers, graduations and indexes, and lettering on name plates to see that they are clearly defined and easily read.

(7) *Paint and finish.* Inspect for bare spots or damaged finish that expose bare metal surfaces and lead to corrosion.

(*a*) Any bare spots or scratches on surfaces for which paint is prescribed must be covered with a film of oil until such time that the materiel can be painted. The paint must not be cracked or peeling. Surfaces of scales and carriage assemblies are commonly covered with colorless lacquer, although they may be protected by a thin coat of lubricating oil.

(*b*) Determine whether touch-up or complete refinishing is to be done; refer to TM 9–2851.

(8) *Lubrication.* Check to see that materiel is properly lubricated (par. 28*h*) in accordance with TB 9–2835–1.

(9) *Cracks.* Plates, castings, and welds should be inspected for cracks and breaks.

(10) *Spare parts and equipment.* Check spare parts and equipment against the pertinent ORD 7 SNL (F–153, F–154, or F–233) for completeness of materiel and equipment.

b. Performance Tests for Sound-Ranging Plotting Boards M1 and M1A1.

(1) *Asymptote range arm assembly.*

(*a*) Loosen the vernier assembly (fig. 10) and move it up and down the asymptote-range-arm scale. There must be no binding.

(*b*) Compress the asymptote-range-arm clamping mechanism (fig. 1); the range arm must be free to move without binding. The range arm must be locked in place by releasing the clamping lever (fig. 10).

(*c*) Move the range arm (fig. 10) over the entire time-difference scale; there must be no binding or rough motion. The range arm must not lift further than one thirty-second inch from the surface of the plotting board.

(2) *Microphone center point assembly.* Place a piece of paper beneath the microphone center point assembly (fig. 11). Depress the microphone center button. The microphone center plotting pin must prick the paper, yet must not be blunted by the surface of the plotting board.

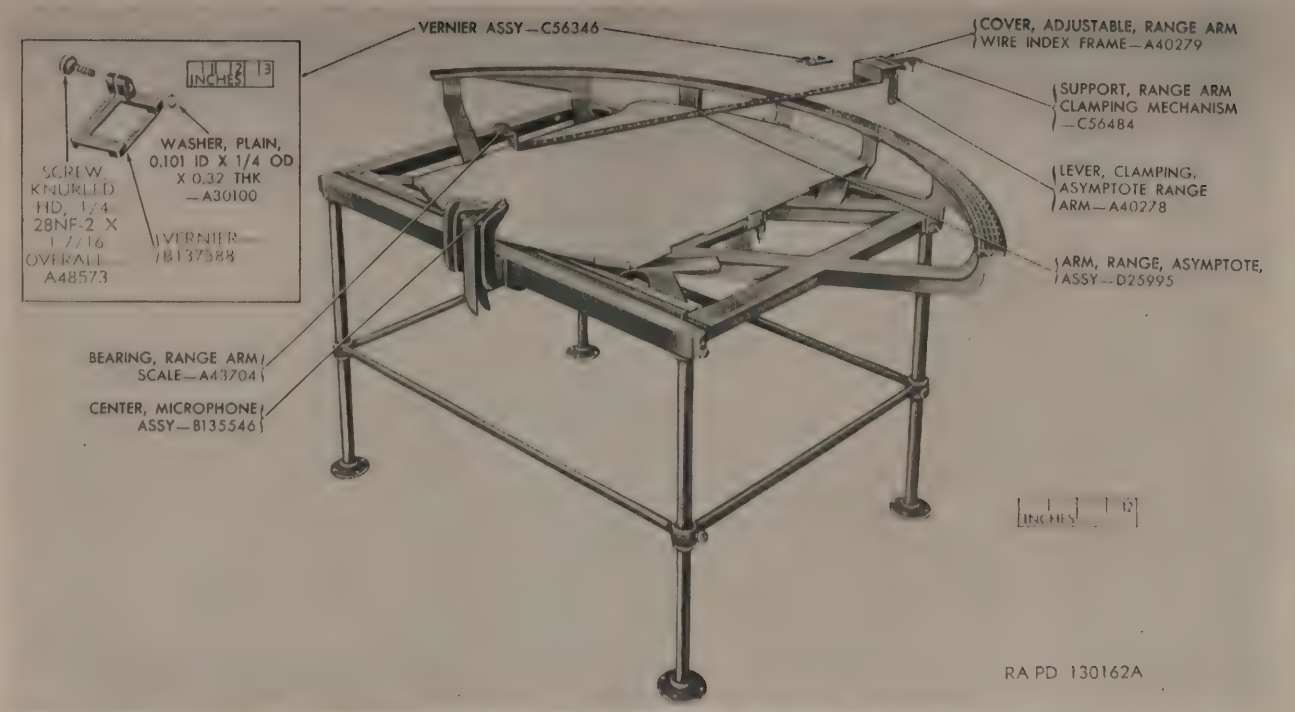


Figure 10. Asymptote range arm assembly and vernier assembly removed (vernier assembly exploded)—sound-ranging plotting board M1 or M1A1.

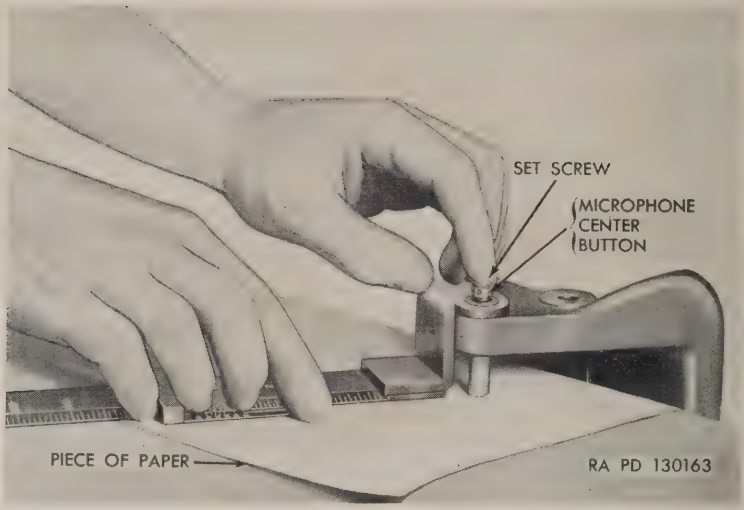


Figure 11. Testing microphone center point assembly—sound-ranging plotting board M1 or M1A1.

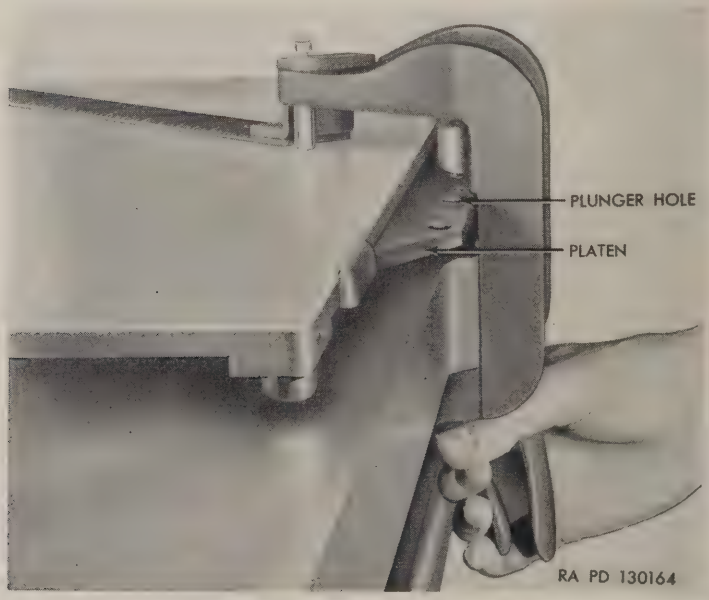


Figure 12. Releasing carriage locating plunger from platen—sound-ranging plotting board M1 or M1A1.

(3) *Straight- or curved-base carriage assembly.*

(*a*) Release either the front or rear tripping lever and lift the carriage locating plunger (fig. 12). Slide the carriage as far as it will move in both directions; there must be no binding. The holes of the platen must move directly beneath the locating plunger as the carriage is moved.

(*b*) Test the front (fig. 13) and rear tripping levers. Make certain that they function properly to release the locating plunger. Refer to paragraph 34, if necessary, to adjust the adjustable rod (fig. 13).

(4) *Frame assembly.* The pivot spindle (fig. 14) must screw in and out of the frame bushing without difficulty.

c. Performance Tests for Sound-Ranging Wind Corrector M1.

(1) *Correction scale.* The correction scale (fig. 8) must travel freely through 360 degrees of the azimuth scale.

(2) *Azimuth scale indexes.* The five azimuth scale indexes (fig. 8) must move freely in the annular groove of the azimuth scale.

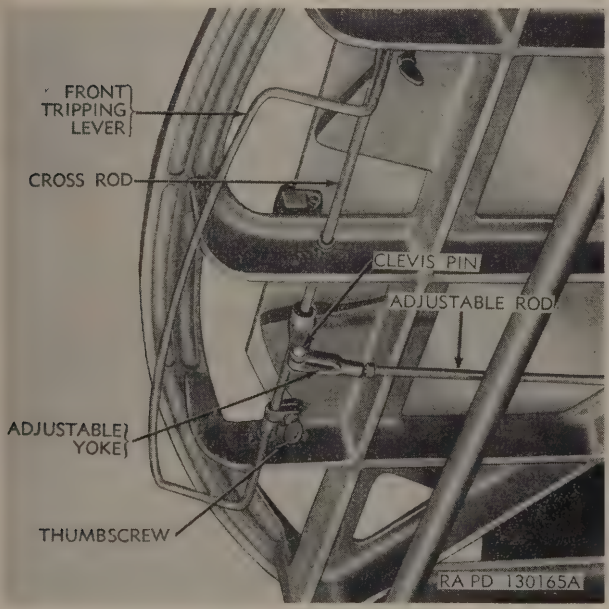


Figure 13. Front tripping lever—assembled view—sound-ranging plotting board M1 or M1A1.

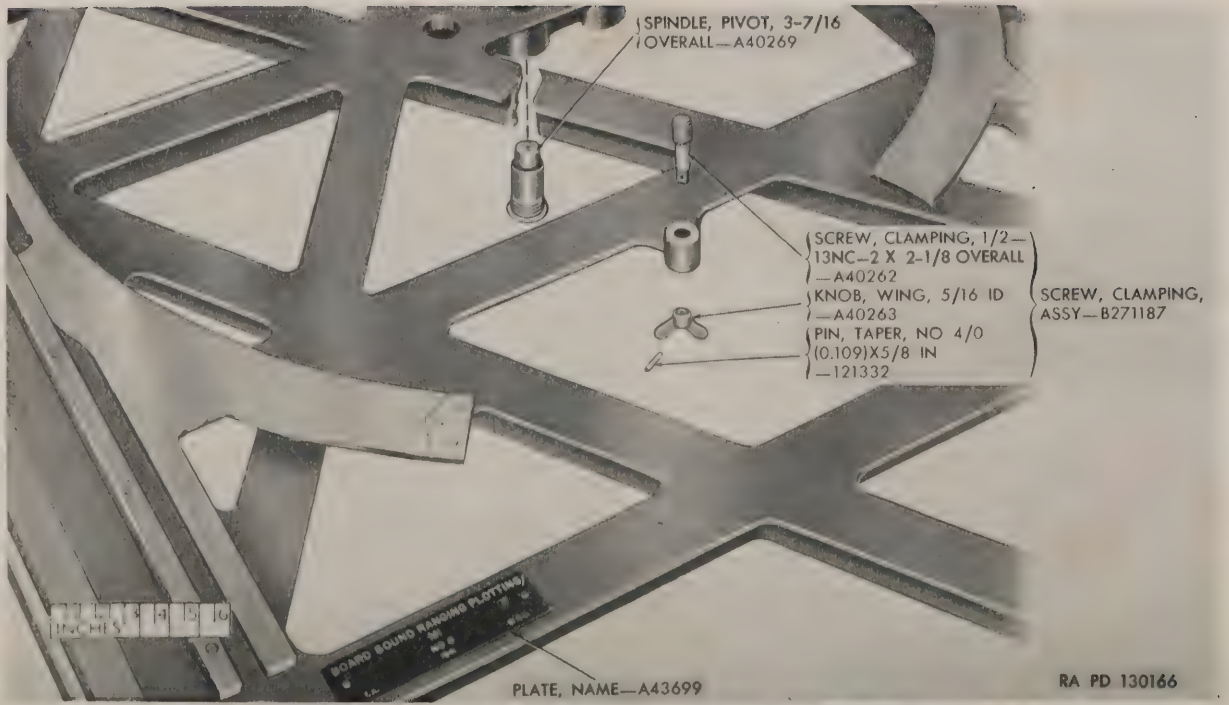


Figure 14. Pivot Spindle and clamping screw assembly—B271187 removed from frame—D43613—sound-ranging plotting board M1 or M1A1

(3) *Wind-velocity-scale arm assembly.* The wind-velocity-scale arm assembly (fig. 8) must traverse freely through the entire area of the sound-ranging wind corrector M1. The arm shall be secured to the center of the correction scale. The clamping screw, when turned counterclockwise, must lock the arm to the azimuth scale.

d. Performance Tests for Plotting Boards M5 and M5A2.

(1) *Drafting machine.* Test the drafting machine (fig. 15) by moving it over the entire area of the grid disk (fig. 15); there must be no binding or sticking. The range scale (fig. 15) must be flat within one thirty-second inch of the grid disk and the edge must be parallel with the grid lines in any position of the scale with the disk in the "0" azimuth position.

(2) *Bracket.*

(*a*) Check the clamping shoe for performance. When the clamping lever is in normal position, the frame must not turn. With the clamping lever compressed, the frame (fig. 15) must be free to travel through 360 degrees.

(*b*) Turn the knob of the lead screw assembly (fig. 15); it must turn freely without sticking. With the clamping lever in normal position (fig. 15), the frame must turn slowly when the knob is rotated.

24. Ordnance Shop Inspection of Sound-Ranging Plotting Boards M1 and M1A1, Sound-Ranging Wind Corrector M1, and Plotting Boards M5 and M5A2

a. General. Technical inspection, performed by the ordnance repair shop upon receipt of materiel turned in for repair, determines the extent of repairs required and provides the basis for requisitioning the parts, assemblies, or supplies necessary to accomplish the repairs. Often this inspection in the shop may be the same as that performed by inspectors in the field. It may disclose additional necessary repairs not indicated by the using organization. General instructions for technical inspections are found in TM 9–2602 and FM 9–10.

b. Procedure. For more detailed inspection beyond the scope of that treated in paragraph 23 the plotting board or wind corrector must be disassembled. Information on inspection of parts is included in the disassembly procedures of chapter 4.

25. Trouble Shooting

Trouble shooting is a systematic isolation of defective components by detection of symptoms and tests for determining defec-

tive components, and includes remedies. The tests and remedies provided in tables III, IV, and V are governed by the scope of the level of ordnance maintenance.

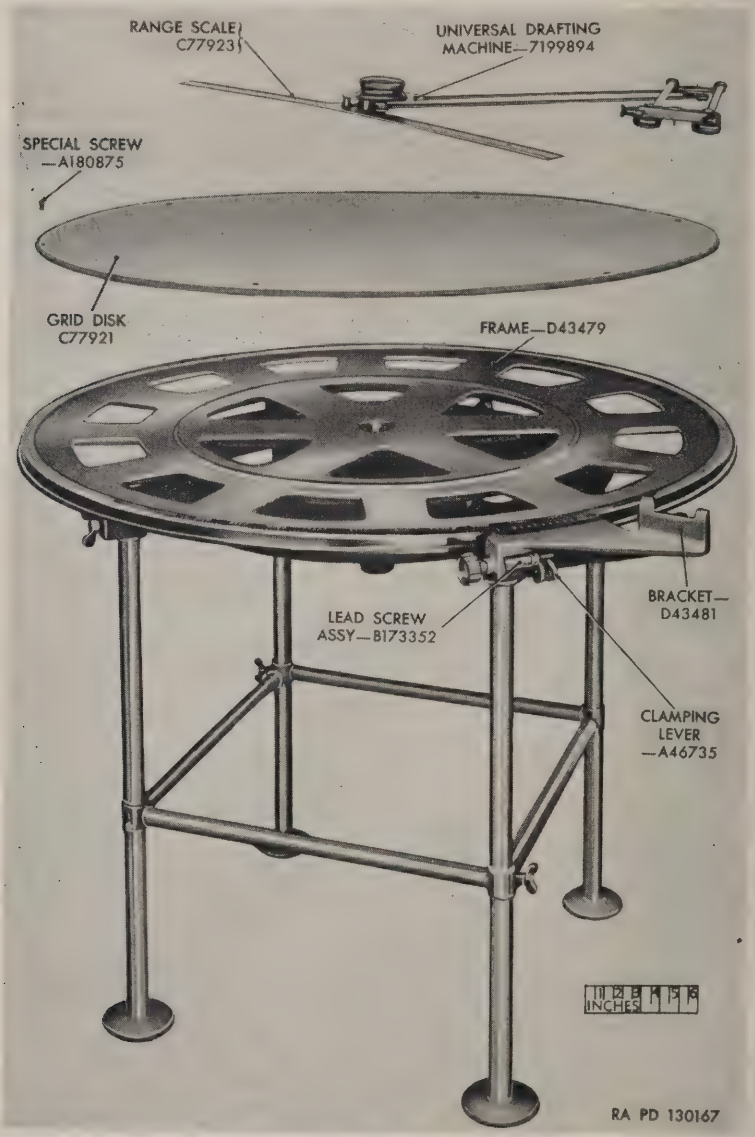


Figure 15. Drafting machine and grid disk removed from plotting board M5 or M5A2.

Table III. Trouble Shooting of the Sound-Ranging Plotting Boards M1 and M1A1.

Malfunction	Probable causes	Corrective action
Asymptote range arm assembly		
Loose arm	Worn scale bearing (fig. 43).	Replace scale bearing (par. 60).
	Loose rivets	Tighten rivets (par 60).
Clamping shoe does not actuate.	Weak or missing spring	Replace spring.
	Inadequate lubrication	Lubricate (par. 28*h*).
	Worn shoe, crank, or pivot.	Replace as required.
Loose or incorrectly adjusted index wire.	Loose or missing fillister-head screws (fig. 16) that secure the index wire frame assembly.	Tighten or replace screws. Adjust index wire (par. 30).
Microphone center assembly		
Point assembly does not prick paper.	Incorrect adjustment	Adjust (par. 31).
	Dull or burred point assembly.	Repair or replace point assembly (par. 61).
	Weak or broken spring	Replace spring (par. 61).
	Inadequate lubrication	Lubricate (par. 28*h*).
	Missing pin	Install pin (fig. 41).
Difficulty in adjustment.	Stripped adjusting screw threads.	Rechase threads; replace as required.
Point assembly not alined with beveled edge of asymptote range arm scale.	Bent point assembly	Replace point assembly (par. 61).
	Bent plunger	Replace plunger (par. 61).
	Assembly out of position in worn bracket.	Loosen set screw (fig. 22) and adjust. Replace bracket if necessary (par. 62).
Carriage assembly (straight or curved)		
Loose plotting plate	Carriage clamping plate assemblies incorrectly tightened.	Tighten clamping plate assemblies (fig. 18).
Loose platen	Loose or missing platen screws.	Tighten or replace flat-head special screws (fig. 25).
Sticking of carriage	Inadequate lubrication of ball bearings.	Lubricate (par. 28*h*).
	Loose components	Tighten as required.
	Unserviceable components.	Repair or install new carriage plates (pars. 58, 64, and 65).
Difficulty in replacing platen.	Loose or missing platen locating pins.	Replace pins; replace platen if necessary.

Malfunction	Probable causes	Corrective action
Front tripping lever with thumbscrew assembly		
Loose lever	Loose thumbscrew(s)	Tighten or replace as required (par. 63).
	Missing cotter pins	Replace (par. 55).
Action of lever inadequate to lift plunger.	Worn cross-rod key (fig. 23).	Replace key (par. 63).
	Worn arm (fig. 23)	Replace (par. 63).
	Incorrectly adjusted rod end yoke.	Adjust (par. 34).
Rear tripping lever		
Loose carriage locating plunger bracket.	Loose hex-head bolts (fig. 26).	Tighten ½–13NC–2 x 1 11/16 bolts (fig. 26).
Action of lever does not lift carriage locating plunger.	Weak or broken spring (fig. 44).	Replace spring (fig. 44).
	Missing straight pin (fig. 26).	Replace 0.201 x ¾ straight pin (fig. 26).
Action of carriage locating plunger link does not lift plunger.	Incorrect adjustment	Adjust yokes (par. 34).
	Missing clevis pin	Replace 5/16 x 1 3/16 pin (fig. 26).
	Missing taper pin	Replace No. 4 x 1 pin (fig. 26).
	Worn 7 5/16 keyed pin	Replace keyed pin (fig. 26).
Frame assembly		
Missing carriage clamping screws.	Missing taper pin for wing knob.	Replace No. 4/0 x ⅝ pin (fig. 14).
Loose or missing leg bushings.	Missing chamfered straight pins.	Replace 3/16 x ⅜ pins (fig. 31).
Loose or missing sound socket bushings.	Missing chamfered straight pins.	Replace 3/16 x 5/16 pins (fig. 31).
Loose or missing round-shoulder bushing.	Missing chamfered straight pins.	Replace 3/16 x ⅜ pins (fig. 31).
Loose time-difference scale.	Damaged or loose straight pins.	Replace 0.064 x 1 1/16 pins (fig. 32).
Loose frame	Loose or missing cap screws.	Tighten or replace.
Frame legs		
Loose or unstable legs.	Damaged, loose, or missing thumbscrews.	Tighten or replace ⅜–16NC–2 x ½ thumbscrews (fig. 29).

Table IV. Trouble Shooting for the Sound-Ranging Wind Corrector M1.

Malfunction	Probable causes	Corrective action
Missing or removable wind-velocity-scale arm pivot screw.	Improperly staked pivot screw (fig. 8).	Replace and/or restake screw.
Missing or removable wind-velocity-scale arm clamping screw.	Improperly staked clamping screw (fig. 47).	Replace and/or restake screw.
Azimuth scale indexes slide with difficulty.	Inadequate lubrication	Lubricate (par. 28*h*).
	Cocking of indexes (fig. 8).	Tighten pins by upsetting upper end (par. 82).
	Slider pins burring azimuth scale groove (fig. 8).	Tighten pins by upsetting upper end (par. 82).

Table V. Trouble Shooting for the Plotting Boards M5 and M5A2.

Malfunction	Probable causes	Corrective action
Drafting machine		
Clearance between machine and grid disk incorrect.	Incorrect adjustment of adjusting screw.	Adjust adjusting knurled-head screw (par. 90) (fig. 48).
	Bent range scale	Repair or replace scale.
Difficulty in moving machine.	Ball bearings insufficiently lubricated.	Lubricate (par. 28*h*).
Range scale loose	Loose flat-head screws (fig. 56).	Tighten No. 10–32NF–3 x ⅜ screws.
Knob loose	Loose flat-head wood screws (fig. 56).	Tighten No. 7 x ¾ wood screws.
	Stripped threads in wooden knob.	Remove knob; fill screw holes with plastic wood; install knob and wood screws.
Frame		
Scratches around circumference of grid disk.	Burs on bracket	Remove burs with fine file.
Spindle assembly screws into flanged bushing two turns or less.	Frame not seated	Reposition frame.

Malfunction	Probable causes	Corrective action
Frame—continued		
	Flanged bushing (fig. 52) incorrectly seated.	Remove bushing and insert properly (par. 115).
	Round nut on spindle incorrectly installed.	Set and secure nut as required (par. 92).
	Spindle threads mutilated (fig. 51).	Rechase threads.
	Flanged bushing threads mutilated.	Rechase threads or replace bushing as necessary (par. 115).
Bracket		
Incorrect readings during inspection.	Vernier (fig. 49) incorrectly adjusted.	Adjust vernier (par. 91).
Loose bracket	Loose or missing hexhead screws; loose chamfered straight pins (fig. 53).	Tighten special screws (fig. 49). If looseness persists, check pin holes in both frame and bracket (fig. 53) for damage or excessive wear. Replace worn parts (par. 109).
Loose lead screw assembly.	Missing taper pin in collar (fig. 60).	Replace No. 4/0 x ¾ taper pin (par. 109).
Loose 1½-inch bronze knob.	Missing taper pin	Replace No. 4/0 x ¾ taper pin (fig. 60).
Loose or missing slide guide.	Loose or missing cone-point headless set screw (fig. 61).	Replace No. 8–36NF–3 x ¼ screw.
Clamping shoe does not actuate.	Missing clamping shoe	Replace shoe (par. 109).
	Missing crank or pivot	Replace crank or pivot (par. 109).
Clamping shoe does not release.	Rust or corrosion on surface of shoe (fig. 62).	Refinish (par. 28*e*).
	Clamping lever compression spring missing or weak (fig. 62).	Replace spring (par. 109).
Loose or missing collar or clamping lever.	Missing taper pin(s)	Replace 1/16 x ½ straight chamfered pins and test. Replace collar or clamping lever if pinholes are worn (par. 109).
Support		
Support loose or wobbly.	Loose or missing thumbscrews (fig. 54).	Replace and/or tighten thumbscrews (½–20NF–2 x 2 overall).
	Loose brace	Replace and/or tighten thumbscrew (⅜ x 1½).

Malfunction	Probable causes	Corrective action
Support—continued		
Frame moves over support with difficulty.	Unserviceable ball bearings.	Replace if necessary; check for missing screws and nuts before discarding bearing (par. 110).
	Central ball bearing incorrectly alined or unserviceable.	Replace ball bearing if necessary (par. 110).
Legs		
Loose or wobbly legs	Loose or missing brace thumbscrews (fig. 64).	Replace and/or tighten thumbscrew (⅜–16NC–3 x 1½ overall).
Removable or missing thumbscrews.	Loose or missing dog-point headless special screw.	Replace or tighten screw (No. 10–32NF–3 x 0.18 overall) (fig. 64).

26. Pre-Embarkation Inspection

a. Inspection for outward appearance of the sound-ranging plotting boards M1 and M1A1, sound-ranging wind corrector M1, and plotting boards M5 and M5A2 is of importance as well as inspection of mechanical condition.

b. Where any doubt exists as to the utility of an assembly or of the plotting board for field artillery, that assembly or the board must be replaced by a serviceable item. Equipment, when inspected, must approach new equipment standards of operation and appearance, and the workmanship and quality of the end product must reflect the highest standards obtainable. To assure that all items, insofar as practicable, possess original appearance, it is desired that items normally painted be repainted, if the painted surface shows signs of damage.

CHAPTER 4

REPAIR AND REBUILD

Section I. GENERAL MAINTENANCE

27. General

a. Information and instructions contained herein are supplementary to instructions for the using organization contained in TM 9–575.

b. This chapter contains general and specific maintenance instructions for the repair and rebuild of each major component. In the following sections, specific adjustments, repairs, and rebuild procedures are described in order to restore each major component to a serviceable condition.

28. General Methods

a. Handling of Disassembled Parts. A parts tray or suitable receptacle should be provided so that small parts, as removed, can be placed in their respective position in relation to the assembled plotting boards or wind corrector. Always keep the relative position of parts until the plotting board or wind corrector is completely assembled. This is especially important where the materiel is assembled by a technician other than the one who disassembled it.

b. Scribing Metal Parts. As each part is removed, its exact position in relation to the assembly should be established by suitably scribed reference marks if it is necessary to return it to its exact original position. Never scribe marks on threads or bearing surfaces.

c. Refilling Scale Graduations. Refill illegible numbers and graduations as follows:

(1) Clean the surface of the scale thoroughly.

(2) Using a scriber or other needle like tool, scrape out all old graduation filler.

(3) Apply white graduation filler liberally over the graduations and force it down into the graduations with a spatula or thin-bladed flexible knife. Wipe with a clean cloth and repeat the process until the graduations are completely filled and level with the surface. Remove all traces of graduation filler outside the graduations and allow the filler to dry for 24 hours.

d. Removal of Burs. Polishing and stoning are necessary to relieve friction and to remove burs. Burs on screw heads, threads, and like surfaces should be removed with a fine file. Care should be observed to stone and file evenly and lightly and not to remove more metal than is absolutely necessary to maintain correct contour of the working surface. Parts or assemblies should never be altered in any way that would affect the interchangeability of the parts.

e. Removal of Rust Spots. All painted surfaces that have become pitted or rusted shall be thoroughly cleaned as directed in (1) and (2) below.

(1) Aluminum-oxide abrasive cloth is used for cleaning finished external surfaces where wear of the parts cleaned will not affect the functioning of the mechanism.

(2) Crocus cloth is used for removing rust or stain and for polishing parts where necessary.

f. Cleaning. This materiel shall be thoroughly cleaned and made free of all foreign matter as directed in (1) through (3) below.

(1) After storage, remove as much external oil, grease, and rust-preventive compound as possible with the use of paper or a soft cloth.

(2) Remove the remainder of the external grease, oil, and rust-preventive compound with a cloth saturated with dry-cleaning solvent or volatile mineral spirits. Clean any small spots of grease or rust compound from the surface of the instrument.

(3) Disassemble each instrument as indicated in the section pertaining to its repair and rebuild and remove all traces of grease, oil, or preservative compound. After thorough cleaning, lubricate immediately with grease and oil as retailed in *h* below and assemble.

g. Prevention of Corrosion. In addition to the prevention of corrosion in the assembled instrument, care must be taken to avoid rust and oxidation of the components of the instrument while it is disassembled. If it is necessary to allow individual parts to remain disassembled for a period exceeding 12 hours, it is recommended that all parts be lubricated with a thin film of aircraft instrument lubricating oil.

Note. In salty atmosphere this oil will become contaminated and must be cleaned off and replaced every 3 days. If the instrument remains disassembled for periods of time exceeding 7 days, use light preventive rust compound. Refer to TM 9–850, SB 9–OSSC–F, and TM 9–2854 for procedures to be followed in the preparation of fire control major items and spare parts for storage.

h. Lubrication.

(1) Lubricate sparingly all operating and adjusting threads (such as the threads of clamping and adjusting screws, the threads of thumbscrews, and the thread of the vernier lead screw of plotting board M5 or M5A2) with aircraft instruments lubricating oil. Sparingly apply this oil to the shank of the wind-velocity scale arm pivot screw of the sound-ranging wind corrector M1.

(2) Lubricate bearings, sliding surfaces, rollers, springs, and other movable and unpainted parts with aircraft and instruments lubricating grease GL. The lubricant will be applied sparingly, particularly during periods of extreme cold, to provide smooth and reasonably free movement. This grease provides for both lubrication and protection against corrosion. Lubricate when necessary and at time of repair or rebuild.

(3) Lubrication prescribed in (2) above will be performed only by ordnance maintenance personnel in accordance with TB 9–2835–1.

Section II. SOUND-RANGING PLOTTING BOARDS M1 AND M1A1

29. General

This section describes the removal, disassembly, inspection of component parts, repair and rebuild, assembly, and installation of the major assemblies of the sound-ranging plotting boards M1 and M1A1. Subassemblies are treated in logical order in relation to their respective major assemblies. Tests and adjustments are covered in paragraphs 30, 31, and 34.

30. Adjustment of Index Wire

The index wire frame cover must be removed before adjustment of the index wire as described in *a* through *c* below.

a. Loosen the two fillister-head screws from the index wire frame assembly (fig. 16).

b. Slide the index wire frame assembly within the asymptote-range-arm support to the point at which the index wire is in line with the beveled edge of the arm scale (fig. 17).

c. Secure the index wire frame assembly in the adjusted position by tightening the two fillister-head screws (fig. 16).

31. Adjustment of Microphone Center Point Assembly

a. Loosen the two headless set screws (figs. 11 and 41) that secure the button to the plunger. Remove the button (fig. 41).

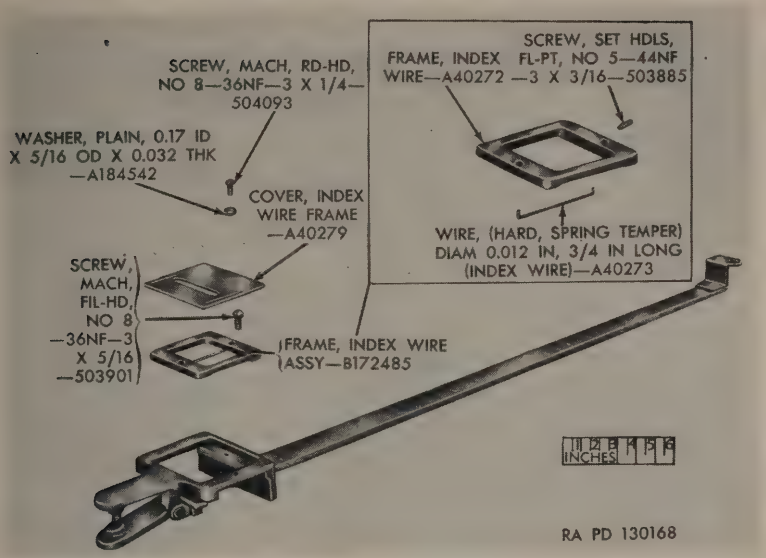


Figure 16. Disassembly of the index wire frame and associated parts—sound-ranging plotting board M1 or M1A1.

b. Place a piece of paper beneath the point of the center assembly (fig. 11). With a screwdriver, adjust the special headless screw (fig. 41) until the point produces a distinct hole in the paper yet does not touch the surface of the plotting plate when the button is pressed.

c. When the desired pin prick is obtained, install the button on the plunger and tighten the set screws.

32. Changing Carriage Assemblies

a. Remove the asymptote arm assembly (par. 35).

b. Raise the carriage locating plunger by means of the front or rear tripping lever.

c. Lift the carriage assembly away from the frame. In the case of curved-base carriage, it is necessary to lift the assembly with care and to make sure that the pivot spindle is disengaged from the bearing adapter. Also, remove the carriage bracket to give clearance to the carriage or remove the platen.

d. The plotting plate is removed from the carriage by loosening the screws of the clamping plate assembly (fig. 18) and lifting the plotting plate from the carriage.

e. Install the new carriage assembly. In the case of the curved-base carriage, make certain that the pivot spindle fits over the

carriage adapter and that the pivot is in the proper adapter bearing.

f. Place a new plotting plate upon the carriage and tighten the clamping plates.

g. Raise the locating plunger (fig. 12) and slide the appropriate platen into position beneath the plunger.

h. Secure the platen to the carriage with seven flat-head screws.

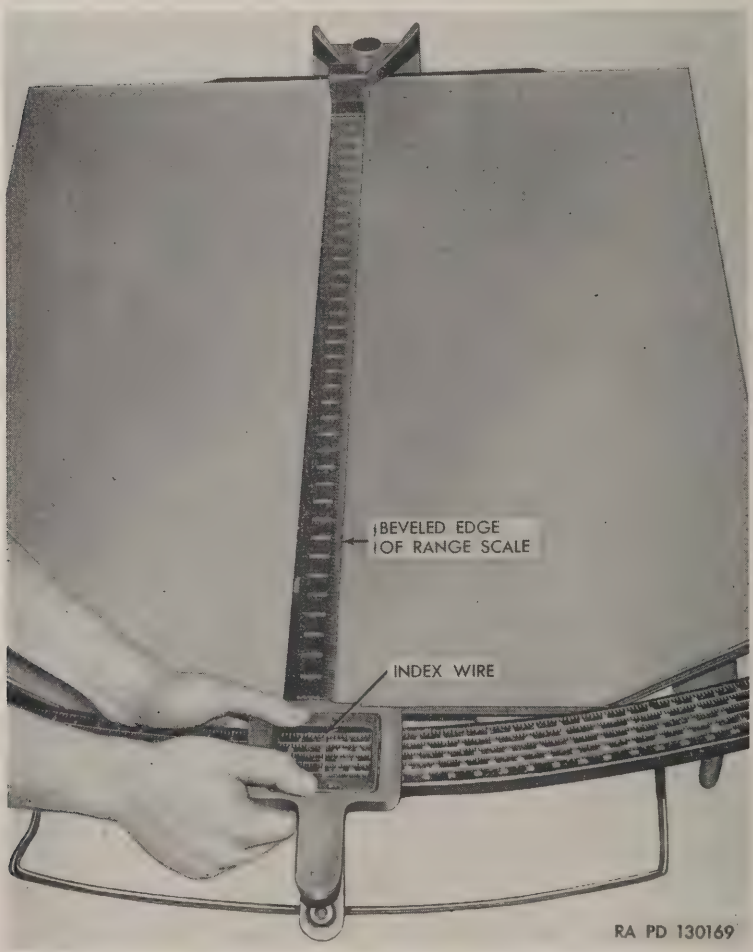


Figure 17. Adjusting index wire with beveled edge of asymptote range arm scale—sound-ranging plotting board M1 or M1A1.

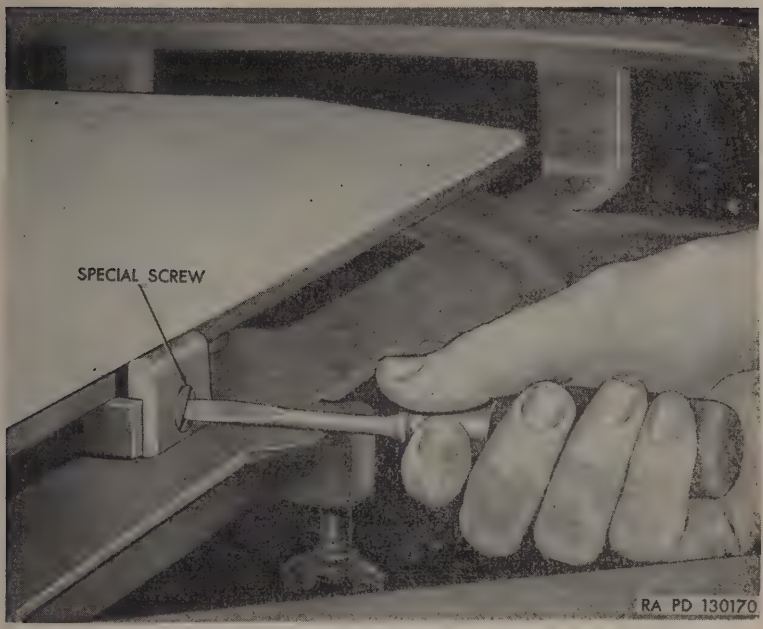


Figure 18. Loosening carriage clamping plate assembly—sound-ranging plotting board M1 or M1A1.

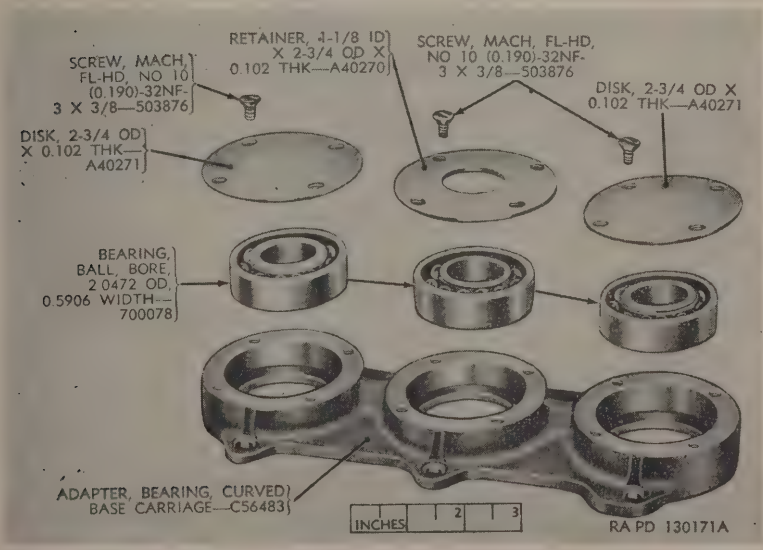


Figure 19. Components of curved-base carriage bearing adapter assembly—sound-ranging plotting board M1 or M1A1.

33. Changing Sound-Second Sockets

To change from one sound-second to another, proceed as directed in *a* through *e* below.

a. Remove the carriage assembly (par. 32).

b. Remove the four flat-head screws that secure the retainer to the bearing adapter (fig. 19). Remove the retainer.

c. Remove the four flat-head screws from the disk (fig. 19) covering the bearing adapter socket to be used.

d. Interchange and secure the disk and retainer with flat-head screws.

e. Remove and reposition the pivot spindle in the appropriate housing of the frame assembly.

34. Test and Adjustment of Rod of Front Tripping Lever

a. Loosen the hex jam nut that locks the 34-inch rod to the adjustable rod end yoke (figs. 13 and 23).

b. Remove the cotter pin and the clevis pin from the front tripping lever cross rod arm and adjustable rod end yoke. This will allow the plunger in the plunger bracket to seat firmly in the tapered hole of the platen (fig. 20).

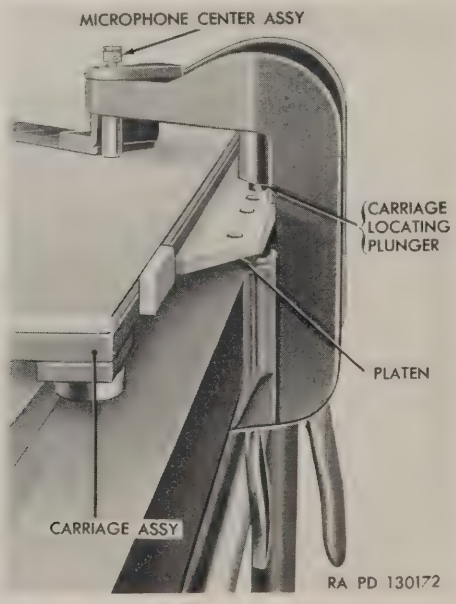


Figure 20. Carriage locating plunger seated firmly in the tapered hole of platen—sound-ranging plotting board M1 or M1A1.

c. Adjust the yoke on the rod so that when the front tripping lever arm is again connected to the yoke the plunger will still be firmly seated in the platen, and the arm will be at 90-degree angle to the rod.

Note. It may be necessary to screw the rod in or out of the rear yoke. Make sure that the rod remains at least seven full turns in the yoke.

d. Screw the front yoke on the rod, and install the clevis pin and new cotter pin.

e. Tighten the two rod jam nuts tightly against the yoke.

f. Test the action of the front lever. When pressed down, it should cause the plunger in the carriage bracket to raise sufficiently to clear the platen, thus allowing the carriage to be moved to another position.

35. Removal of Asymptote Range Arm Assembly

a. Lift the scale bearing (fig. 10) of the arm assembly free of the microphone center assembly.

b. Compress the clamping lever (fig. 21) until the clamping shoe clears the frame.

Caution: Exercise extreme care that the machined surfaces of the asymptote range arm are not damaged during removal.

c. Carefully lift the arm assembly, with vernier attached, out and away from the frame.

d. Loosen the knurled-head screw on the vernier and carefully lift the vernier from the arm assembly (fig. 10).

Note. If the knurled-head screw is to be removed, it will be necessary to cut or file off the peened end of the screw, then unscrew the screw from the vernier. Do not force the screw.

36. Removal of Microphone Center Assembly (fig. 22)

Remove the cone-point headless set screw that locks the microphone center assembly in the bracket. Then push the assembly upward and out of the bracket.

37. Removal and Disassembly of Front Tripping Lever Assembly

a. Loosen the thumbscrews of the front tripping lever and remove the four cotter pins from the cross rod and one washer from each end of the rod (fig. 23).

b. Remove the cotter pin from the clevis pin securing the cross rod arm to the rod (fig. 23). Remove the clevis pin.

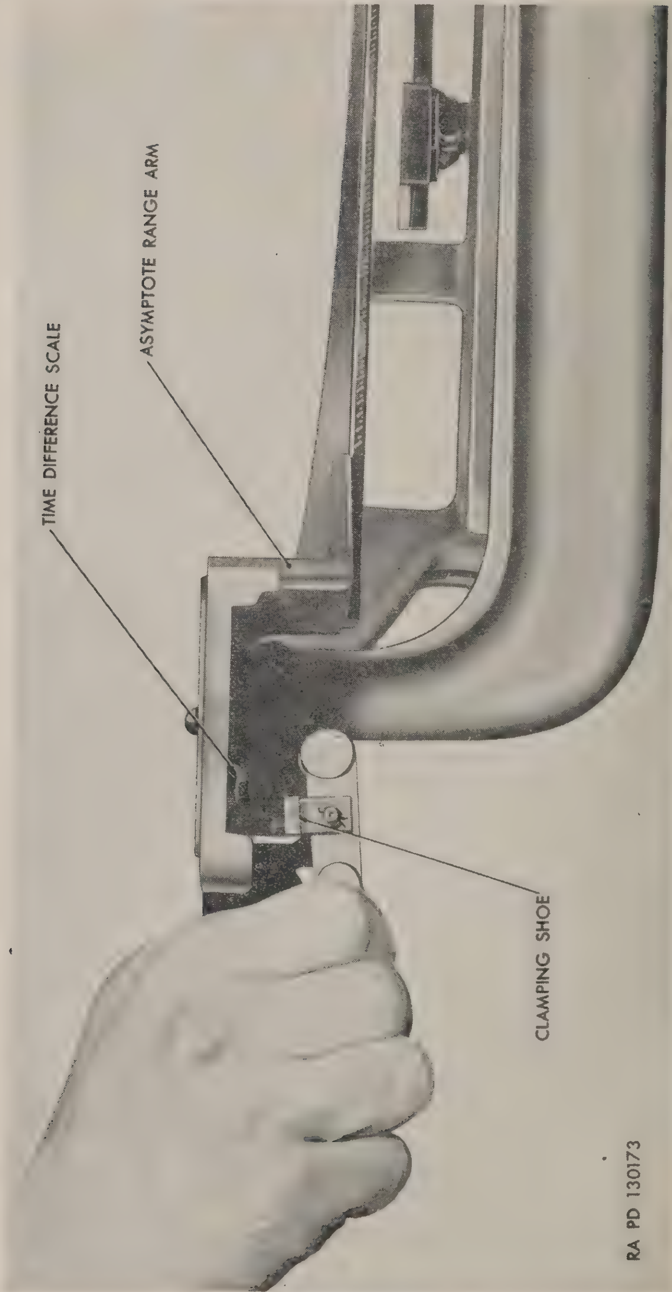


Figure 21. Compressing the clamping lever of asymptote range arm—sound-ranging plotting board M1 or M1A1.

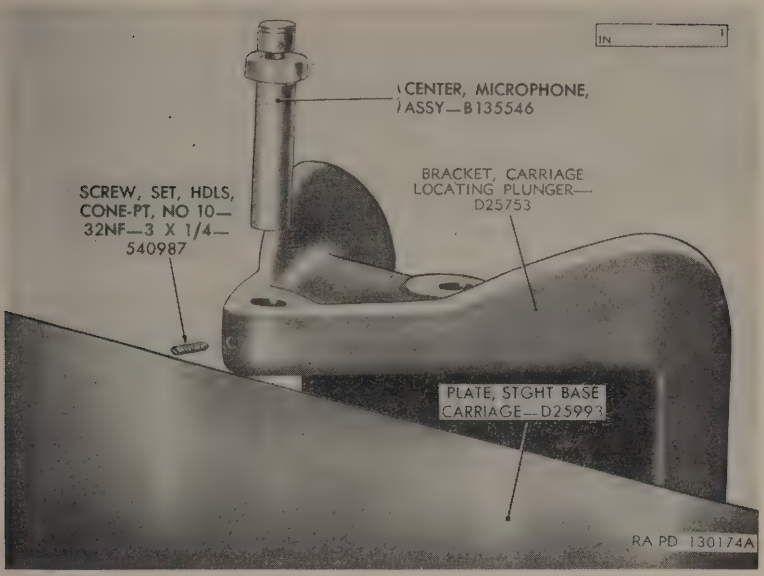


Figure 22. Microphone center assembly removed from carriage locating plunger bracket—sound-ranging plotting board M1 or M1A1.

c. Slide the cross rod arm a few inches along the cross rod to expose the key, then remove the key from the rod.

d. Remove the cross rod, with two washers, by sliding it in either direction through the frame bushings. Remove the front tripping lever (fig. 23).

e. If necessary to remove the thumbscrew, cut or rechase the end threads, then unscrew the thumbscrew.

38. Removal of Rear Tripping Lever

a. Remove the cotter pin from the clevis pin securing the adjustable rod end yoke (fig. 24) to the lever crank. Withdraw the clevis pin and separate the yoke from the crank (K, fig. 26).

b. Alternately unscrew the two hex-head bolts (E, fig. 26) that secure the carriage locating plunger bracket (D, fig. 26) to the frame assembly.

Note. To avoid loss, these two bolts are retained to the bracket by two $\frac{1}{16}$ x $\frac{5}{8}$ cotter pins (fig. 25). Do not remove cotter pins unless necessary.

c. Drive out the taper pins that secure the lever crank (K, fig. 26) and the lever to the $7\frac{5}{16}$-inch pin (A, fig. 26). Remove the crank.

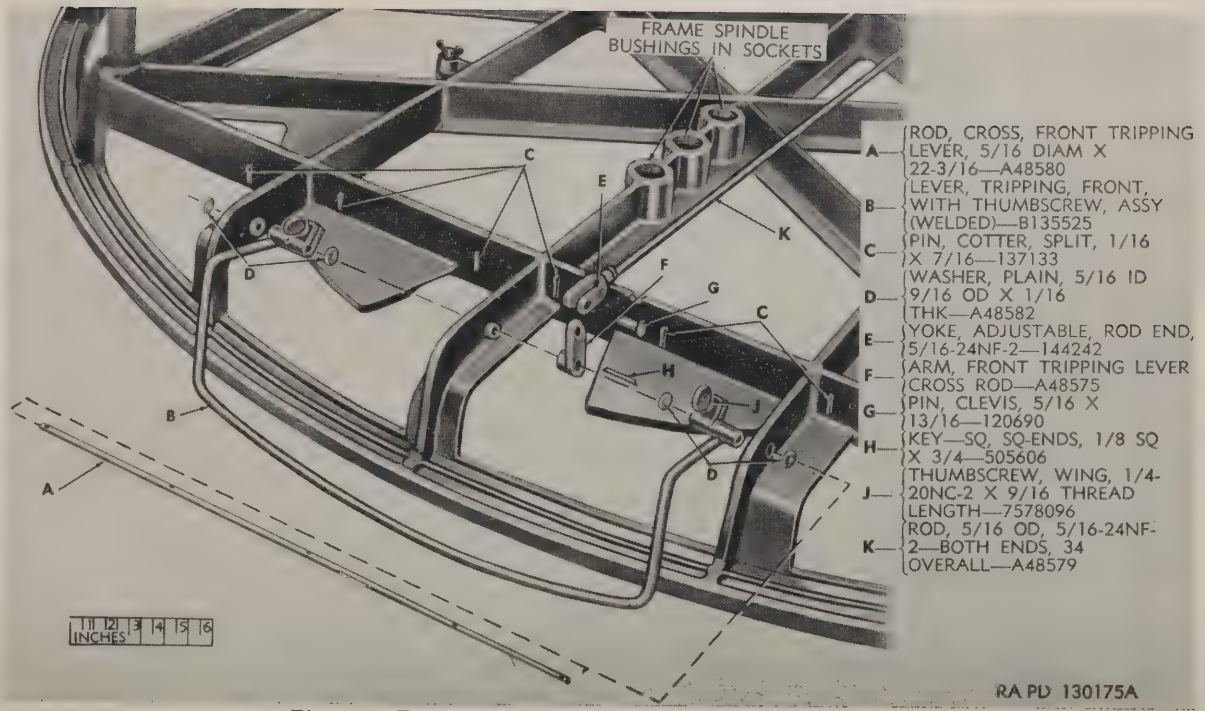


Figure 23. Front tripping lever assembly and associated parts—sound-ranging plotting board M1 or M1A1.

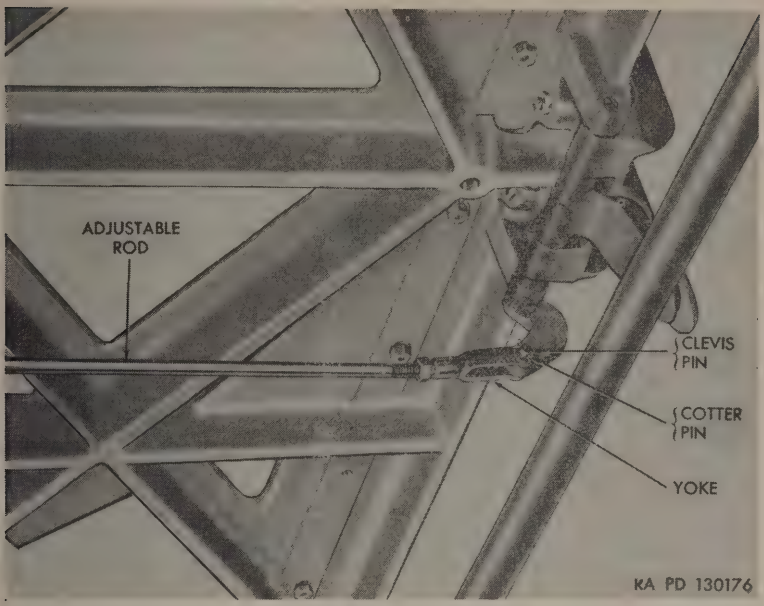


Figure 24. Rear tripping lever assembly in assembled position—sound-ranging plotting board M1 or M1A1.

d. Remove the cotter pins from the straight pin (B, fig. 26) that connects the rear tripping lever to the plunger link (fig. 44). Withdraw the straight pin.

e. Slide the $7\frac{5}{16}$-inch pin (A, fig. 26) out of the frame assembly mounting holes. This action frees the rear tripping lever and the plunger bracket.

39. Removal of Plotting Plate, Carriage Assembly, and Platen (Straight-Base Carriage)

Note. The plotting board M1 or M1A1 may use a straight- or curved-base carriage assembly.

a. Alternately unscrew the two hex-head bolts that secure the plunger bracket to the frame.

Note. Do not remove $\frac{1}{16}$ x $\frac{5}{8}$ cotter pins (fig. 25) retaining bolts to bracket.

b. Tilt back the plunger bracket from its upright position over the carriage assembly (fig. 25).

c. Loosen the two flat-head special screws that secure the two clamping plate assemblies (fig. 18) to the plotting plate. Lift the plotting plate from the carriage.

d. Remove the seven special screws (fig. 25) that secure the platen to the carriage.

e. Press down gently on the platen to release the platen from the locating pins on the underside of the carriage.

f. Compress the right- and left-straight-base carriage roller arms on under side of carriage to allow bearing to clear guide rail. Raise carriage from frame.

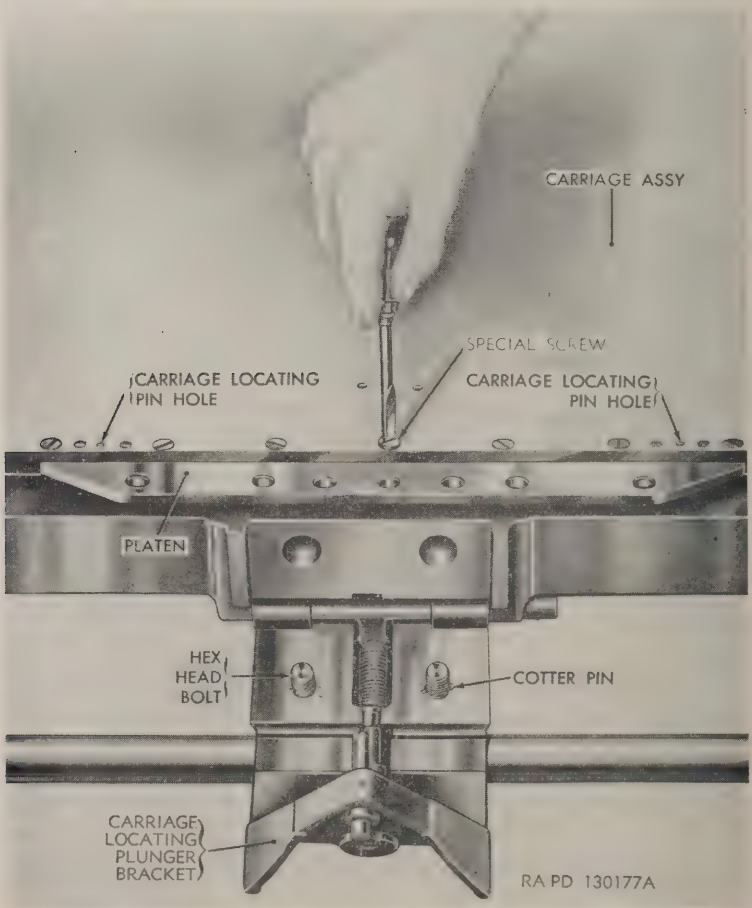


Figure 25. Removing platen from straight-base carriage assembly—sound-ranging plotting board M1 or M1A1.

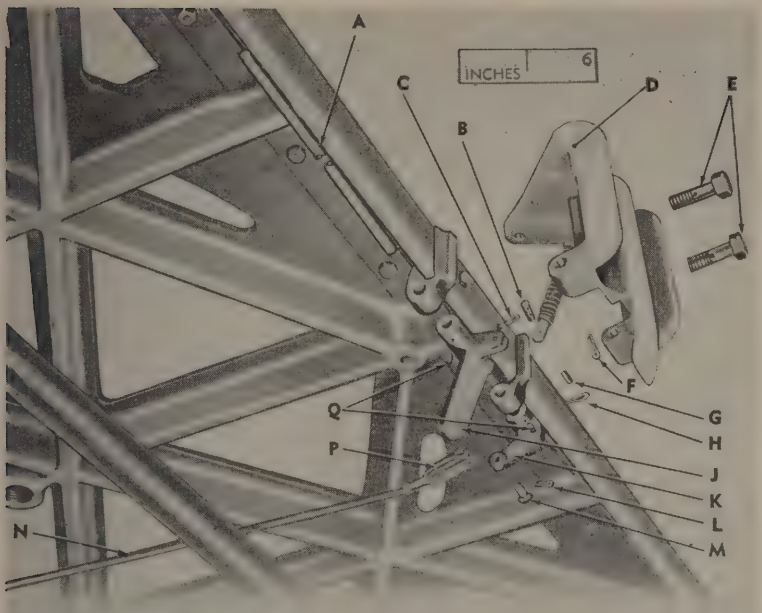


Figure 26. Rear tripping lever and associated parts—exploded view—sound-ranging plotting board M1 or M1A1.

40. Removal of Plotting Plate, Carriage Assembly, and Platen (Curved-Base Carriage)

a. Remove plotting plate and platen as described in paragraph 39*a* through *e*.

b. Lift the curved-base carriage assembly from the frame. Take care that the pivot spindle (fig. 27) will withdraw from the bearing (fig. 19) on the under side of the carriage without binding.

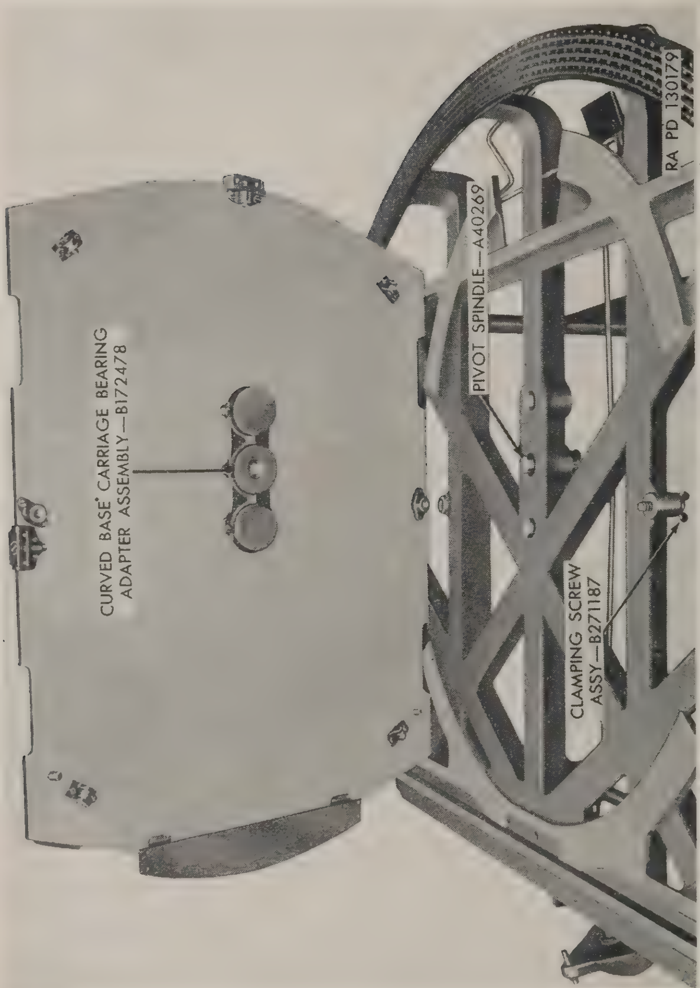


Figure 27. Curved-base carriage assembly with carriage tilted away from frame—sound-ranging plotting board M1 or M1A1.

41. Removal of Frame Assembly

Remove the four hex-head screws (fig. 28) that secure the frame assembly to the four legs. Lift the frame from the legs.

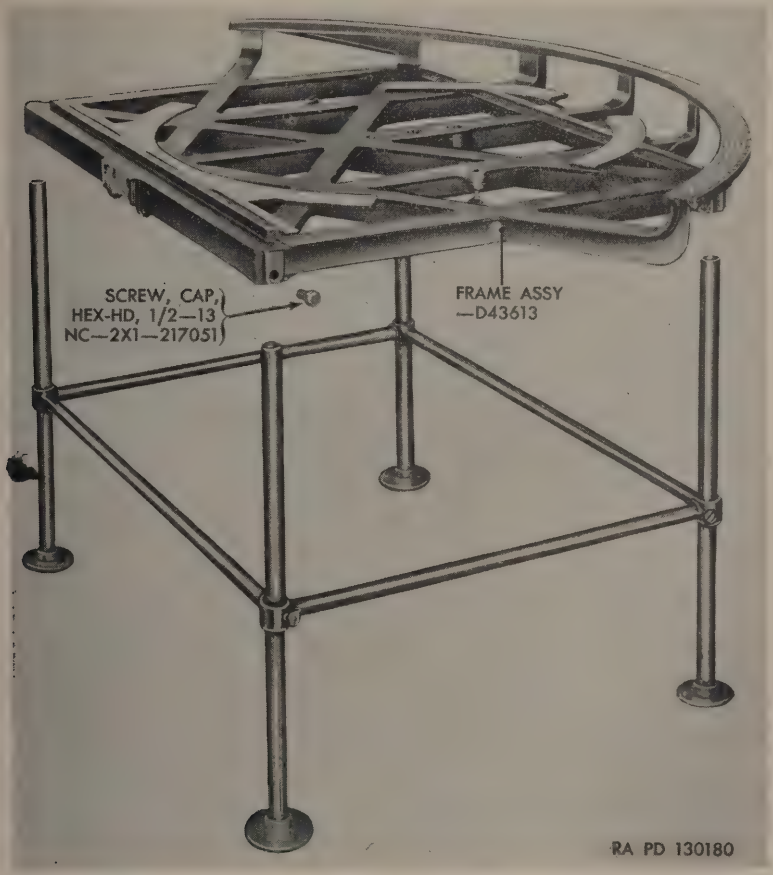


Figure 28. Frame assembly removed from the legs—sound-ranging plotting board M1 or M1A1.

42. Disassembly of Legs and Brace

a. Loosen the four thumbscrews of the brace assembly (fig. 29) and slide the brace from the frame legs.

b. If replacement of thumbscrews is necessary, file off the peened end of each thumbscrew and remove thumbscrews.

c. Unscrew the flange from each frame leg (fig. 29).

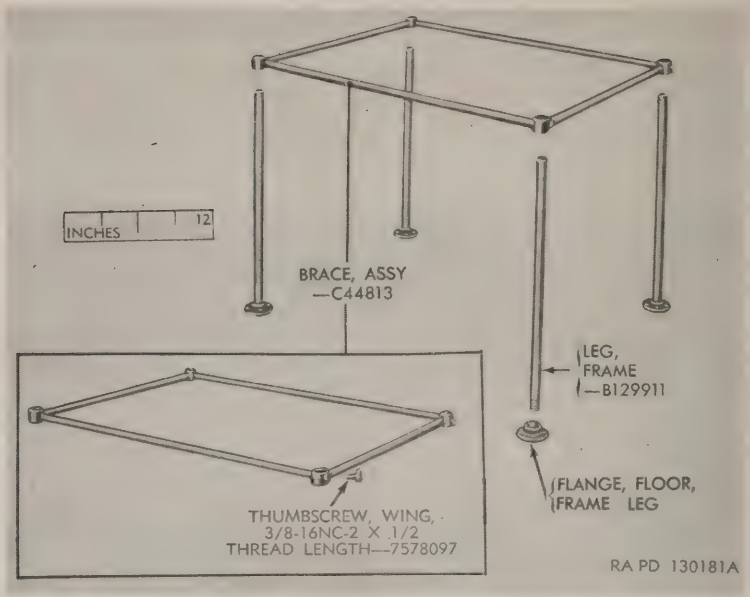


Figure 29. Brace assembly removed from legs—sound-ranging plotting board M1 or M1A1.

43. Disassembly of Frame

a. Drive the taper pin out of the wing knob on each of the clamping screws (fig. 14) and drive the knobs off the screws.

b. Unscrew clamping screws upward through the frame (fig. 14).

c. Unscrew and remove the pivot spindle. This spindle has a ¾-inch hex knob on the lower end and is removed from the lower side of the frame.

d. Remove the two No. 8 x ¼ round-head screws attaching the name plate (fig. 14) to top right side of frame. Remove name plate.

e. Working from the under side of the frame, drive the 3/16-inch straight chamfered pin upward through each of the four frame leg bushings. With a diamond-point chisel or punch, crack or drive each bushing into frame socket (fig. 30). These leg bushings fall free through the frame socket.

f. Remove the three bushings (C, fig. 31) by tapping out the diagonally inserted 3/16-inch chamfered straight pin (D, fig. 31) that secures each frame bushing; then, working from top side of frame with a diamond point chisel, crack each bushing and drive through the frame socket.

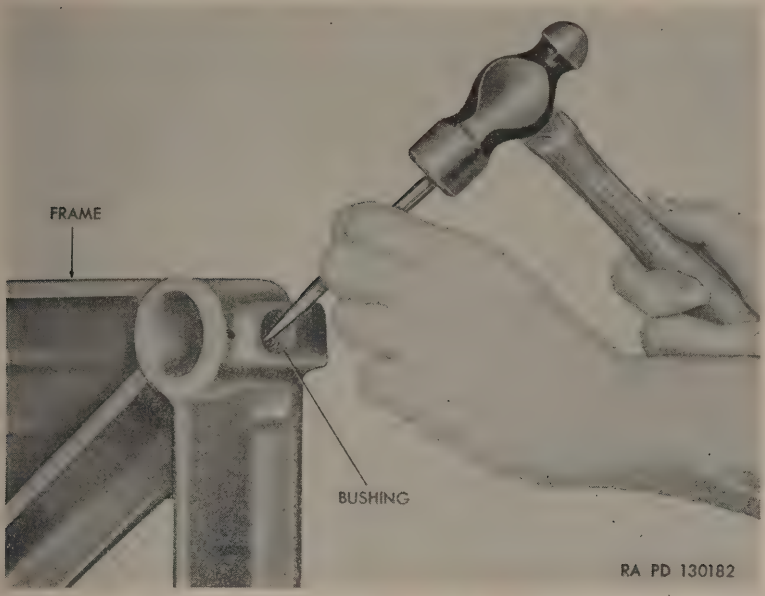


Figure 30. Cracking frame leg bushing with diamond point chisel—sound-ranging plotting board M1 or M1A1.

g. Remove the chamfered bushing (E, fig. 31) and the round-shoulder bushing (B, fig. 31) through which the front tripping lever cross rod is installed by cutting with diamond point chisel and driving the bushings free.

h. Remove the two round-shoulder bushings (G, fig. 31) that receive the two bolts (fig. 25 and E, fig. 26) securing the plunger bracket to the frame by tapping each chamfered straight pin (F, fig. 31) through bushings. Cut bushings with diamond point chisel and drive free through bolt holes from bracket side.

Note. In the event that any of the chamfered straight pins cannot be driven out, drill out pins with appropriate drill.

i. Working from the top side of the frame, remove eight screws, lock washers, and hex nuts that secure the frame guide rail (fig. 32) to the frame. Carefully lift the rail from the frame.

j. Removal of the time-difference scales may result in damage to the scales. For this reason, remove the scales only for purpose of replacement. Do so by driving out the five straight pins that secure each scale to the frame assembly (fig. 32).

k. Drive out the three rivets and remove the frame stop (fig. 32).

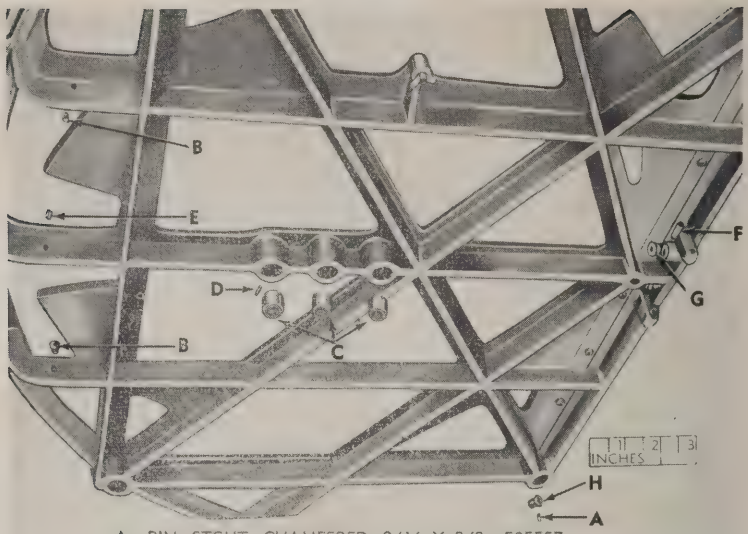


Figure 31. Bottom view of frame assembly—sound-ranging plotting board M1 or M1A1.

44. Disassembly of Carriage

a. Removal of Carriage Roller Arm Assembly (fig. 33).

(1) Remove the two flat-fillister-head special screws (F) that secure the two straight-base carriage roller arm assemblies (G and S) to the carriage plate (U).

(2) Remove each roller arm assembly.

b. Removal of Carriage Roller Plate Assembly (fig. 33).

(1) Remove the two flat-head screws (E) that secure each of the two roller plate assemblies (D) to the carriage plate (U, fig. 33).

(2) Drive out the straight pins (C) that position the roller plate assembly on the carriage plate.

(3) Remove the roller plate assemblies.

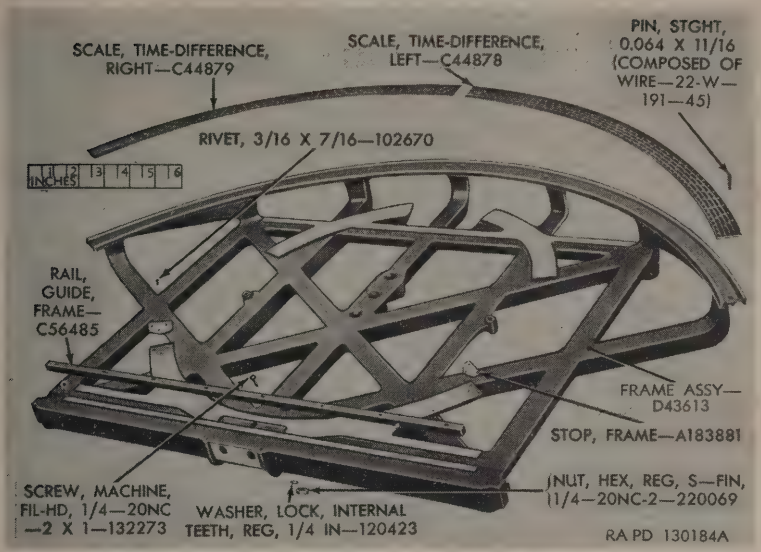


Figure 32. Frame assembly—(exploded view) sound-ranging plotting board M1 or M1A1.

c. Removal of Carriage Roller Assembly.

(1) Remove two fillister-head screws (M, fig. 33) and two internal-teeth lock washers (N, fig. 33) that secure each of the six roller assemblies (L, fig. 33 and fig. 34) to the carriage plate.

(2) Remove the roller assemblies.

d. Removal of Carriage Flange.

(1) Remove the fillister-head screws and internal-teeth lock washers that secure the two flanges (figs. 34 and 35) to the carriage plate.

(2) Remove the flanges.

e. Removal of Carriage Clamping Plate and Bracket.

(1) Remove the two fillister-head screws and lock washers that secure the plate blacket to the plate assembly (figs. 34 and 35).

(2) Remove the bracket and associated parts. Repeat the procedure for the other plate bracket.

f. Removal of the Plotting Plate Carriage Stops.

(1) Remove each of the four stops (B, fig. 33 and fig. 36) from the carriage plate by unscrewing the two flat-head screws (A, fig. 33) securing each stop to the plate.

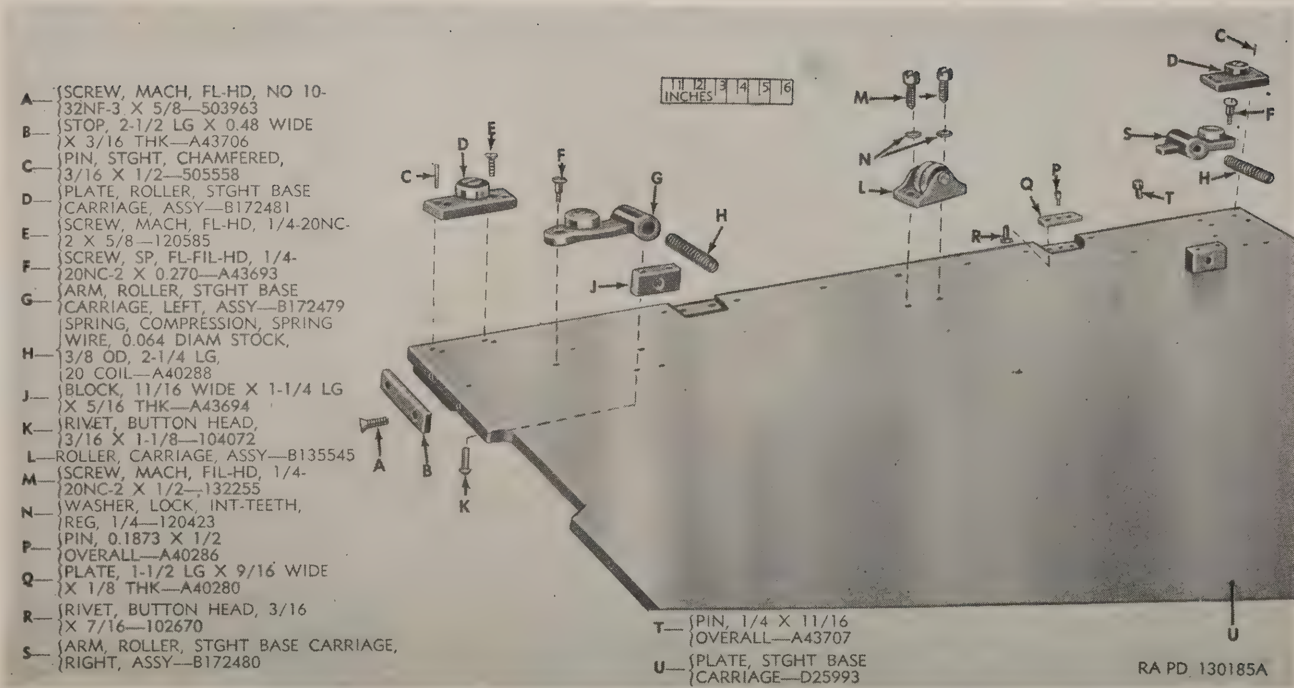


Figure 33. Components of straight-base carriage assembly—sound-ranging plotting board M1 or M1A1.

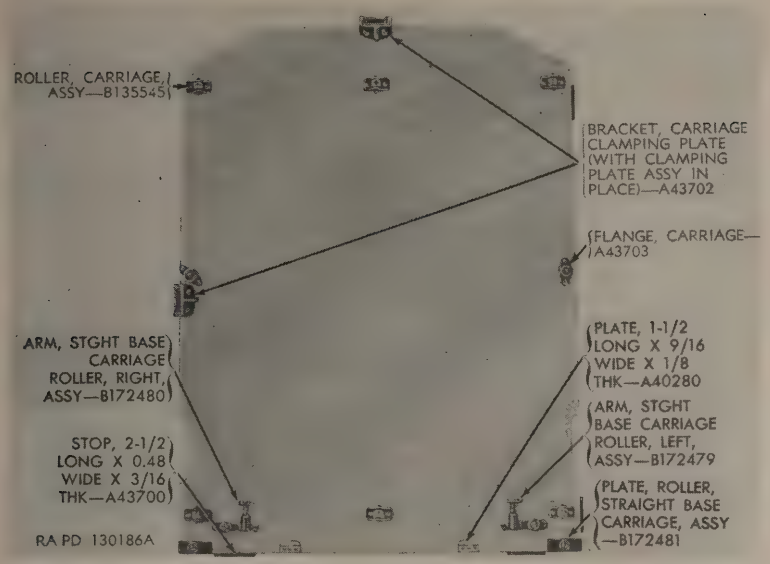


Figure 34. Straight-base carriage assembly—sound-ranging plotting board M1 or M1A1.

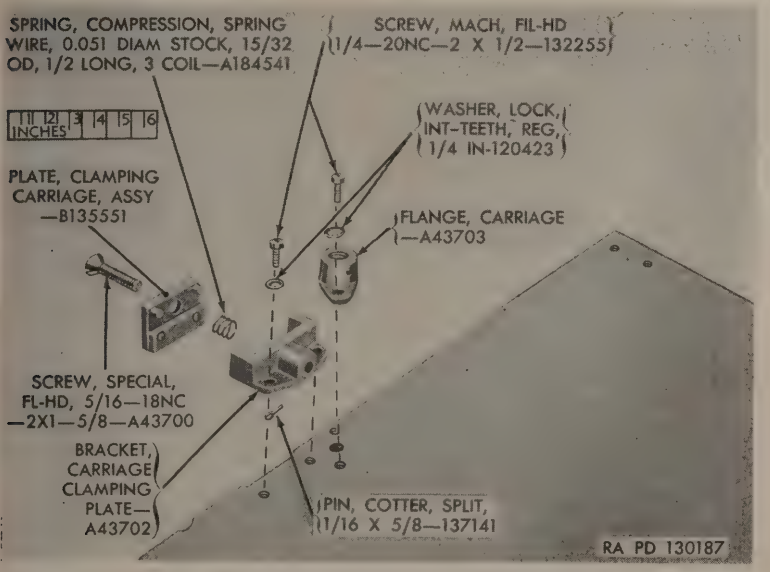


Figure 35. Component assemblies of the straight-base carriage assembly—sound-ranging plotting board M1 or M1A1.

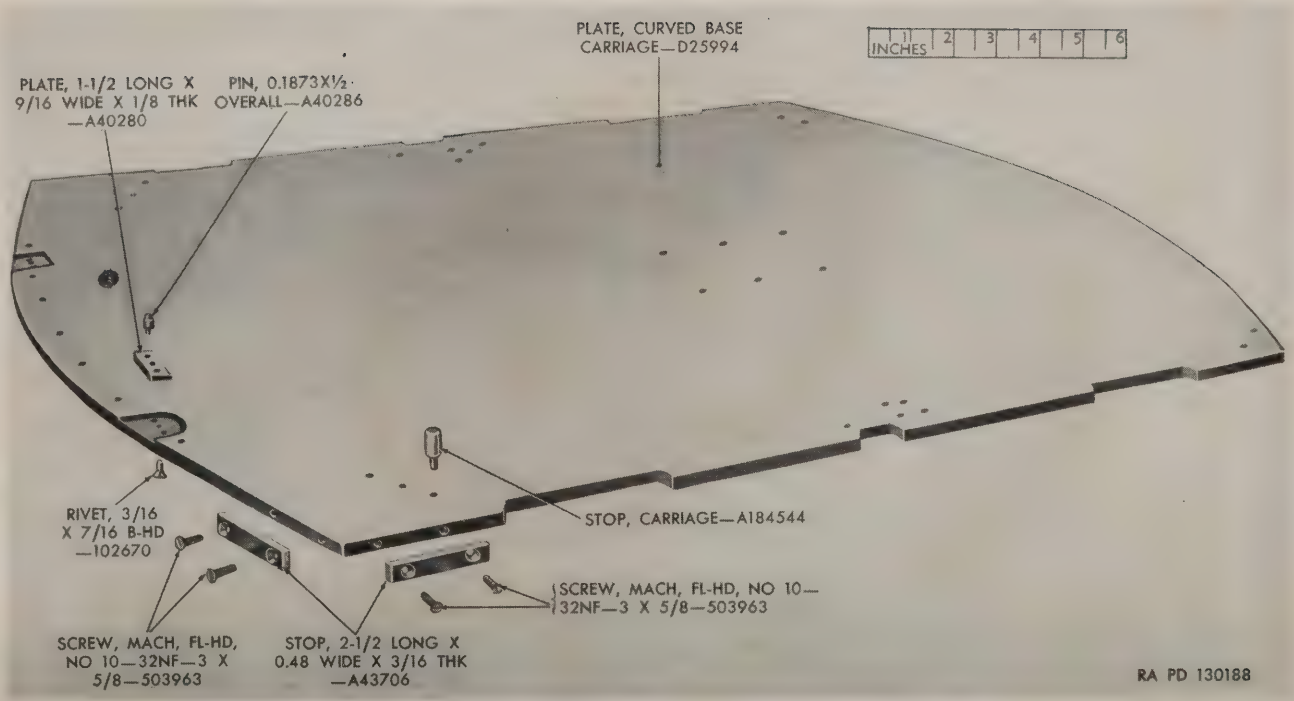


Figure 36. Associated parts of curved-base carriage assembly removed from carriage plate.

(2) Remove the stops.

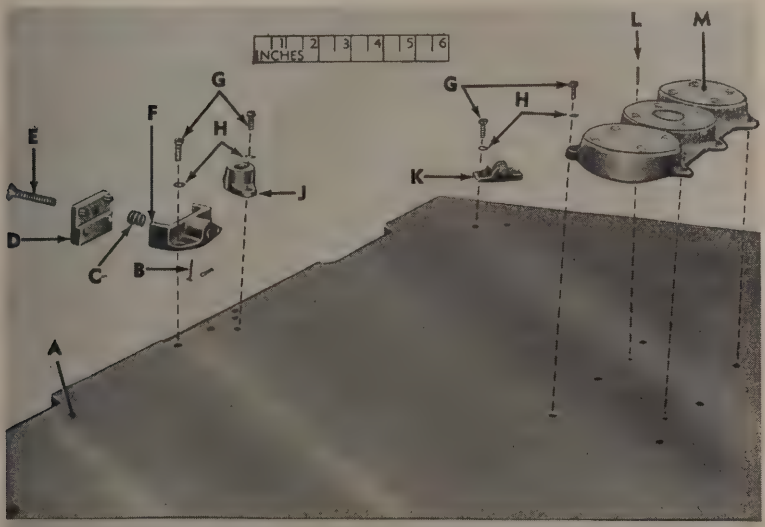
g. Removal of Plates.

(1) File off the heads of the two button-head rivets (R, fig. 33) securing each of the plates (Q, fig. 33) to the carriage plate (fig. 36).

(2) Drive out the rivets and remove the plates.

h. Removal of Carriage Locating Pins. If it is necessary to remove the two chamfered straight pins that serve as locating pins (fig. 25), use a soft-jawed tool and lift the pins from the carriage plate.

i. Removal of the Two Carriage Stops From Curved-Base Carriage Plate. Drive out the two carriage stops (fig. 36) from the under side of the curved-base carriage plate.



A—PLATE, CURVED BASE CARRIAGE—D25994
B—PIN, COTTER, SPLIT, 1/16 X 5/8—137141
C—{SPRING, COMPRESSION, SPRING WIRE, 0.051 DIAM
{STOCK, 15/32 OD, 1/2 LG, 3 COIL—A184541
D—PLATE, CLAMPING, CARRIAGE, ASSY—B135551
E—SCREW, SP, FL-HD, 5/16-18NC-2 X 1-5/8—A43700
F—BRACKET, CARRIAGE CLAMPING PLATE—A43702
G—SCREW, MACH, FIL-HD, 1/4-20NC-2 X 1/2—132255
H—WASHER, LOCK, INT-TEETH, REG, 1/4—120423
J—FLANGE, CARRIAGE—A43703
K—ROLLER, CARRIAGE, ASSY—B135545
L—PIN, STGHT, CHAMFERED, 3/16 X 1/2—505558
M—{ADAPTER, BEARING CURVED BASE
{CARRIAGE, ASSY—B172478

RA PD 130189A

Figure 37. Component assemblies of the curved-base carriage assembly—sound-ranging plotting board M1 or M1A1.

j. Removal of the Curved-Base Carriage Bearing Adapter (fig. 37).

(1) Remove the six fillister-head screws (G) and internal-teeth lock washers (H) that secure the bearing adapter (M) to the curved-base carriage plate (A).

(2) Lift the bearing adapter assembly up and away from the curved-base carriage plate, being careful not to damage the chamfered straight pins (L) that position the adapter.

45. Disassembly of Straight-Base Carriage Roller Arm

a. Slide the compression spring (H, fig. 33) from its recess in the roller arm (G and S, fig. 33).

b. Remove the special screw that secures the ball bearing (fig. 38) to the roller arm. Remove the bearing.

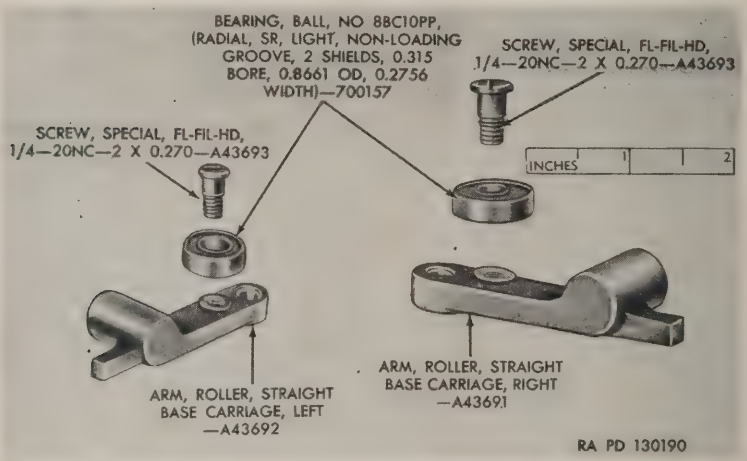


Figure 38. Components of the right and left straight-base carriage assemblies —sound-ranging plotting board M1 or M1A1.

46. Disassembly of Carriage Roller Plate Assembly (fig. 39)

a. Remove the special screw that secures the ball bearing to roller plate.

b. Separate the bearing and plate. Repeat the procedure for other roller plate assembly.

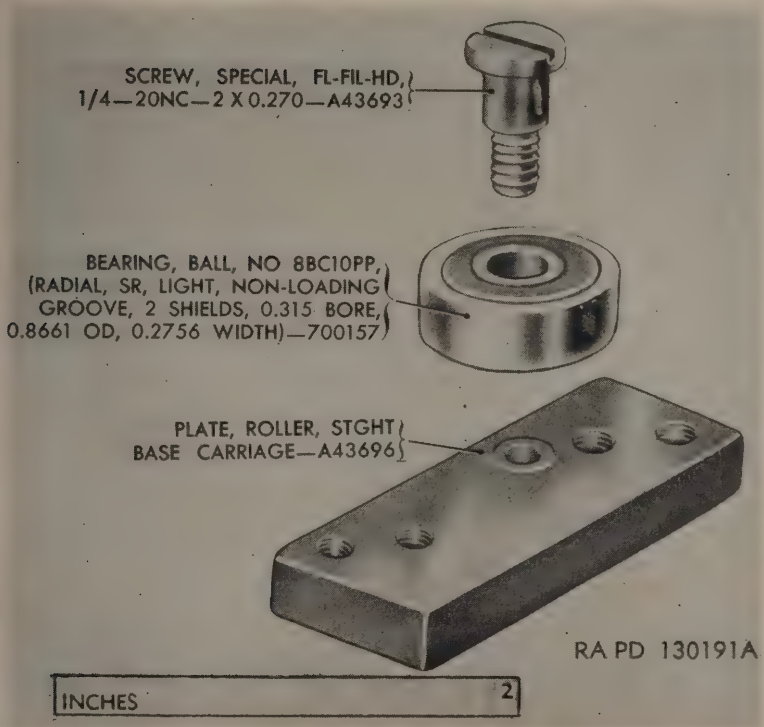


Figure 39. Components of the straight-base carriage roller plate assembly—sound-ranging plotting board M1 or M1A1.

47. Disassembly of Carriage Roller Assemblies (fig. 40)

a. Remove the two hex nuts and the lock washer from the special screw that runs through the carriage roller bracket.

b. Withdraw the special screw and remove the two ball bearings and plain washers.

Note. Do not disassemble the ball bearing; no replacement parts are issued.

48. Disassembly of Carriage Clamping Plate

a. Remove the cotter pin from the flat-head special screw (fig. 35) holding the clamping plate to the clamping plate bracket.

b. Remove the flat-head special screw and separate the clamping plate, bracket, and compression spring (fig. 35).

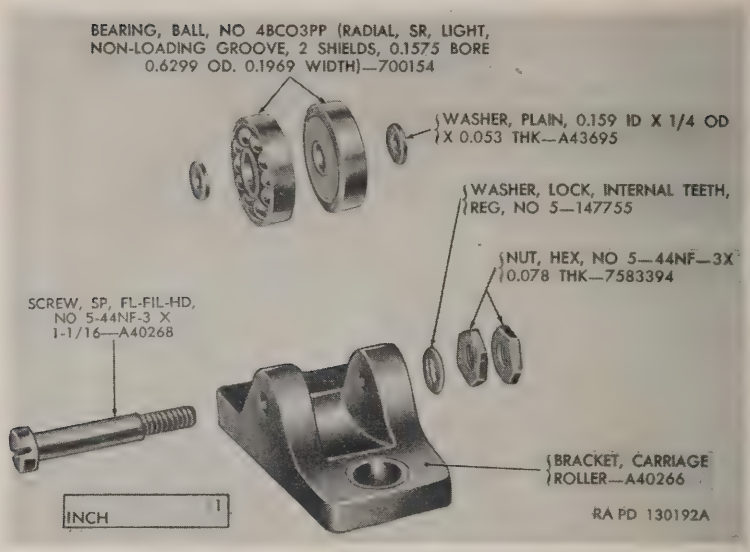


Figure 40. Components of the carriage roller assembly—sound-ranging plotting board M1 or M1A1.

49. Disassembly of Curved-Base Carriage Bearing Adapter Assembly

a. Remove the four flat-head screws and lock washers from each of the two retaining disks and the retainer of the adapter assembly (fig. 19). Remove the disks and retainer.

b. Gently drive out the two outer ball bearings. The center bearing is a drive fit and must be removed with a bearing puller.

50. Disassembly of Microphone Center Assembly (fig. 41)

a. Unscrew and remove the retaining ring. This releases the compression spring.

b. Remove the two headless cone-point set screws that hold the microphone center plunger to the plunger button. Slide button off the plunger.

c. Unscrew and withdraw the microphone center point assembly from the plunger.

d. If necessary to disassemble the center point assembly, remove the solder from the special screw and withdraw the pin.

e. Slide the center plunger from the bearing.

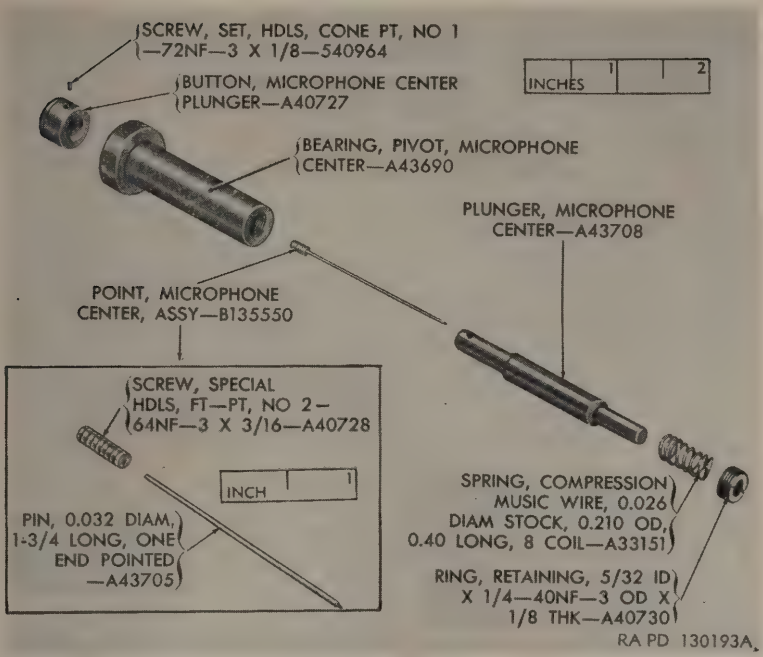


Figure 41. Components of the microphone center assembly—sound-ranging plotting board M1 or M1A1.

51. Disassembly of Asymptote Range Arm Assembly

a. Unscrew and remove the two round-head screws and plain washers securing the wire index frame cover (fig. 16) to the wire index frame assembly. Remove the cover.

b. Unscrew and remove the two fillister-head screws that secure the wire index frame assembly (fig. 16) to the clamping mechanism (fig. 42).

c. Lift the index wire frame assembly from its recess in the clamping mechanism.

d. Release the index wire from the index wire frame by unscrewing the two headless set screws (fig. 16). Be careful not to bend the wire.

e. Disassemble the clamping mechanism as directed in (1) through (3) below.

(1) Tap out the taper pin (B, fig. 42) that secures the clamping lever (K, fig. 42) to the clamping lever crank (E, fig. 42).

(2) Slide the clamping lever from the crank and withdraw the crank.

(3) Release and remove the compression spring (C, fig. 42) from the clamping support (fig. 43) by unscrewing the fillister-head screw.

f. Remove and disassemble the clamping shoe assembly as directed in (1) and (2) below.

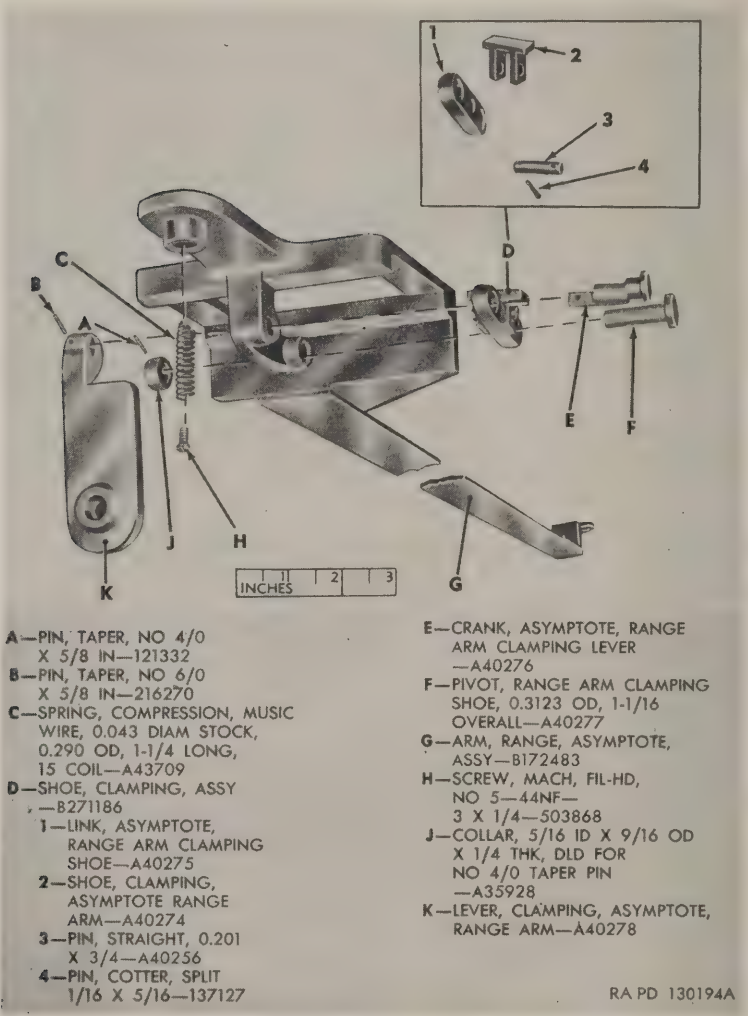


Figure 42. Disassembly of the asymptote range arm clamping mechanism—sound-ranging plotting board M1 or M1A1.

(1) Tap out the taper pin (A, fig. 42) from the collar (J, fig. 42) retaining the link pivot (F, fig. 42). Remove the collar and pivot. This permits the shoe assembly to fall free.

(2) Withdraw the cotter pin (D4, fig. 42) from the straight pin (D3, fig. 42) connecting the shoe link (D1, fig. 42) to the shoe (D2, fig. 42). Remove the straight pin and separate the link from the shoe.

g. Remove the support from the scale assembly (fig. 43) by driving out the two $\frac{3}{8}$-inch chamfered straight pins and removing four rivets that secure the support to the scale assembly.

h. Separate the scale bearing from the scale by tapping out the two $\frac{5}{16}$-inch chamfered straight pins (fig. 43) and removing the four rivets holding the bearing to the scale.

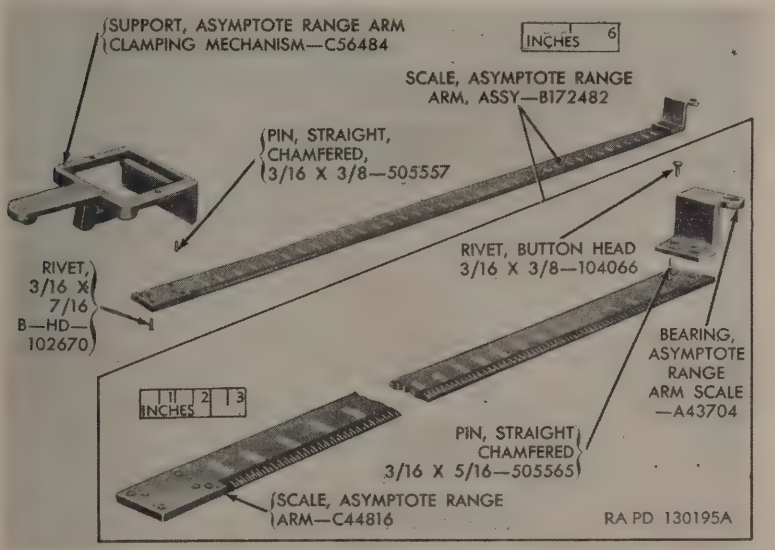


Figure 43. Asymptote range arm (without clamping mechanism) disassembled —sound-ranging plotting board M1 or M1A1 (M1 shown).

52. Disassembly of Rear Tripping Lever (fig. 26)

a. The rear tripping lever and plunger bracket are removed as described in paragraph 38.

b. Slide the compression spring and plain washer from the plunger link.

c. Remove two cotter pins from the straight pin that connects the plunger link to the mechanism plunger stud. Withdraw the straight pin.

d. Remove the link, plunger assembly, and guide bushing from the bracket.

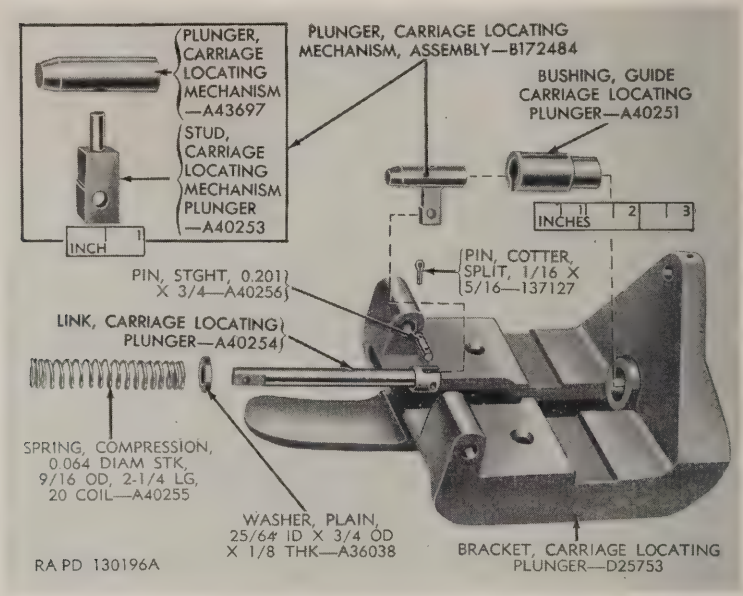


Figure 44. Carriage locating plunger bracket with plunger and link—sound-ranging plotting board M1 or M1A1—exploded view.

53. Repair and Rebuild of Microphone Center Assembly

a. Replace burred screws.

b. Specifications of spring should be: free height 0.40 inch; 8 coils; support 1.96 pounds at 0.25 inch.

c. Replace all worn or damaged parts.

d. Lubricate all parts as prescribed in paragraph 28*h*.

54. Repair and Rebuild of Asymptote Range Arm Assembly

a. Replace worn or damaged screws or washers.

b. Replace all pins.

c. Straighten any minor bends in range arm.

d. Remove any small dents or burs (par. 28*d*) from scales. Refill scale as described in paragraph 28*c*.

e. Replace rusted or corroded index wire.

f. Replace tension spring not meeting this specification: free length 1¼ inches; 15 coils; load at solid height 12 pounds.

g. Replace all worn or damaged parts.

h. Lubricate all parts as prescribed in paragraph 28*h*.

55. Repair and Rebuild of Front Tripping Lever

a. Remove minor bends or replace seriously damaged assembly.

b. Replace all cotter pins.

c. Lubricate parts as prescribed in paragraph 28*h*.

56. Repair and Rebuild of Rear Tripping Lever

a. Replace all cotter and taper and clevis pins if worn or damaged.

b. Replace worn spring not meeting this specification: 20 coil, 2¼ inches free length.

c. Remove burs from metal surfaces with a fine file (par. 28*d*).

d. Replace all worn or damaged parts.

e. Lubricate parts as prescribed in paragraph 28*h*.

57. Repair and Rebuild of Frame

a. Remove burs from machined surfaces (par. 28*d*).

b. Replace worn bushings.

c. Replace all worn or damaged parts.

d. Replace damaged time scales.

e. Lubricate parts as prescribed in paragraph 28*h*.

58. Repair and Rebuild of Straight- Or Curved-Base Carriage

a. Replace all damaged screws and washers.

b. Replace all damaged pins and springs.

c. Replace any ball bearing that does not roll smoothly or that wobbles.

d. Replace all worn or damaged parts.

e. Lubricate parts as prescribed in paragraph 28*h*.

59. Repair and Rebuild of Legs

a. Remove bends or dents from legs and brace.

b. Remove burs from threads (par. 28*d*).

c. Replace any worn or damaged part.

d. Lubricate all parts as prescribed in paragraph 28*h*.

60. Assembly of Asymptote Range Arm

a. Secure the scale bearing (fig. 43) to the scale with two $\frac{3}{16}$ x $\frac{5}{16}$ chamfered straight pins and four $\frac{3}{16}$ x $\frac{3}{8}$ button-head rivets.

Note. Secure the bearing to the end of the scale marked "0."

b. Secure the clamping mechanism support (fig. 43) to the scale assembly with two $\frac{3}{16}$ x $\frac{3}{8}$ chamfered straight pins and four $\frac{3}{16}$ x $\frac{7}{16}$ button-head rivets.

c. Assemble the clamping shoe assembly to the support as directed in (1) through (4) below.

(1) Place the link (D1, fig. 42)in position in the clamping shoe (D2, fig. 42). Insert a straight pin (D3, fig. 42) through the shoe and the center hole of the link and secure with a new cotter pin (D4, fig. 42).

(2) Secure the clamping shoe assembly (D, fig. 42) to the support (fig. 43) by inserting the pivot (F, fig. 42) through the round hole in the link (D1, fig. 42) of the shoe assembly and the hole at the end of the "L" shaped portion of the support (fig. 42). Face the clamping surface of the shoe upward.

(3) Install the collar (J, fig. 42) over the pivot, and secure it in place with a No. 4 x $\frac{5}{8}$ taper pin (A, fig. 42).

(4) Insert the clamping lever crank (E, fig. 42) through the elongated hole in the clamping shoe link and through the support.

d. Place the clamping lever (K, fig. 42) on the crank so that the tapered holes aline; secure by inserting a No. 6 x $\frac{5}{8}$ taper pin (B, fig. 42) through the lever and crank.

e. Place compression spring (C, fig. 42) in its recess on the support and secure it in place with a No. 5 x $\frac{1}{4}$ fillister-head screw (H, fig. 42).

f. Install the index wire (hard, spring temper, diam 0.012 inch, $\frac{3}{4}$ inch long) in the underside of the index wire frame (fig. 16) and secure with two No. 5 x $\frac{3}{16}$ flat-point headless set screws.

Note. Test the index wire for tightness.

Adjust the index wire by means of the set screws until the wire is taut.

g. Secure the index wire frame assembly to the support with two No 8 x $\frac{5}{16}$ fillister-head screws (fig. 16).

h. Place the index wire frame cover (fig. 16) on the frame assembly and secure with two No. 8 x $\frac{1}{4}$ round-head screws and two $\frac{5}{16}$-inch OD plain washers.

i. Place the knurled-head screw (fig. 10) through the unthreaded hole and screw it into the vernier. Place a $\frac{1}{4}$-inch OD plain washer over the protruding threaded end of the screw, then rivet the end of the screw so that the washer will not slide off.

61. Assembly of Microphone Center
(fig. 41)

a. If the microphone center point assembly was disassembled, install the 0.032 x 1¾ pin in the No. 2 x 3/16 headless flat-point special screw with solder.

b. Insert the center point assembly into the plunger and screw it into its proper position. Refer to paragraph 31 describing proper adjustment.

c. Insert the plunger in the threaded end of the pivot bearing.

d. Slide the compression spring onto the end of the plunger and then screw the retaining ring securely into the pivot bearing.

e. Position the center button on the plunger with the screw holes alined with the countersunk holes on the plunger, then securely install the two No 1 x 1/8 headless cone-point set screws.

62. Assembly and Installation of Rear Tripping Lever

Note. The key letters noted in parentheses are in figure 26, except where otherwise indicated.

a. Insert the plunger stud into the plunger (fig. 44), rivet the end over, and finish flush with the surface of the plunger.

b. Press the guide bushing in its recess in the plunger bracket.

Caution: Care must be exercised to aline the center of the slot in the guide bushing with a line (extended through the slot) passing through the centers of the guide bushing and the hole for the microphone center assembly. Face the slot away from the hole for the center assembly.

c. Secure the plunger link (fig. 44) to the plunger with a 0.201 x ¾ straight pin and two 1/16 x 5/16 cotter pins.

d. Insert the plunger (fig. 44), flat end first, into the guide bushing. Turn the link, to which the plunger has been attached, so that the plunger stud fits into the slot of the guide bushing.

e. Slip one ¾-inch OD plain washer and a 20-coil compression spring (fig. 44) onto the plunger link.

f. Secure the rear tripping lever to the free end of the plunger link with a straight pin (B) and two new cotter pins (C).

g. Place the bolts in the plunger bracket and secure with new cotter pins (fig. 25). Place the plunger bracket (with plunger and tripping lever assembled) in position against the frame assembly and secure the bracket to the frame, using the two bolts (E).

h. Slide the keyed pin (A) through one of the rear tripping lever mounting holes on the frame. Continue insertion of the pin through the plunger bracket (D), tripping lever (J), and the other mounting hole of the bracket and frame.

i. Secure the rear tripping lever to the keyed pin (A) with a taper pin (Q).

j. Place the crank (K) on the end of the keyed pin (A) and secure with a taper pin (Q).

k. Connect the crank to the adjustable rod end yoke with a clevis pin (M) and new cotter pin (L).

63. Assembly and Installation of Front Tripping Lever (fig. 23)

a. If the two wing thumbscrews (J) were removed from the front tripping lever, install two new thumbscrews and rivet the end threads over.

b. Start the cross rod (A) through the right-hand "L" beam of the frame with the key slot positioned for the correct location of the arm (F).

c. Place a plain washer (D) on the cross rod after the rod passes through the thumbscrew clamp at the end of the front tripping lever, with thumbscrew, assembly (B). Slide the cross rod through the center beam of the frame.

d. Place the key (H) in the cross rod and install the arm (F) on the cross rod with its bushing facing the center beam. Aline key and keyway, then slide the arm midway over the key.

e. Place another plain washer (D) on the cross rod and slide the rod through the other thumbscrew clamp at the end of the front tripping lever, with thumbscrew, assembly (B). Slide the cross rod through the other "L" beam of the frame assembly.

f. Secure the cross rod arm (F) to the rod (K) with a clevis pin (G) and new cotter pin (C).

g. Place a plain washer (D) on each end of the cross rod.

h. Insert four new cotter pins (C) through the cross rod (A), one at each end of the cross rod to secure the washers and one to secure each of the previously installed washers against the thumbscrew clamps at the ends of the front tripping lever, with thumbscrew, assembly (B).

64. Assembly of the Straight-Base Carriage

Note. The key letters noted in parentheses are in figure 33, except where otherwise indicated.

a. Install each of the two plates (Q) in place on the lower edge of the carriage plate (U). Install the pin (P) and secure in place with two button-head rivets (R).

b. Position each of the four stops (B) on the plate assembly (fig. 34) and secure each with two flat-head screws (A).

c. Install a ball bearing No 8BC10PP on the right and also on the left roller arm (fig. 38); secure each with a ¼ x 0.270 flat-fillister-head special screw.

d. Position the two blocks (J) in place on the carriage plate; secure each in place with two button-head rivets (K).

e. Place the compression spring in the recess in each roller arm assembly (G and S) and position both arms on the plate assembly with the ball bearing upward and the spring against the block.

f. Secure each roller arm assembly to the plate assembly (figs. 33 and 34) with a flat-fillister-head special screw (F). Insert the pin (T) in the carriage plate, to hold each arm in position, then rivet it securely to the plate.

g. Place one plate bracket on the side of the carriage plate and the other on the front edge of the plate assembly.

h. Secure each of the plate brackets to the carriage plate with two ¼ x ½ fillister-head screws and two ¼-inch internal-teeth lock washers (fig. 35).

i. Insert the compression spring (fig. 35) in each of the plate brackets.

j. Place the clamping plate assembly in position with the leather pad against the plate bracket and with the pins in the mating holes. Secure the clamping plate to the bracket with a 5/16 x ⅝ flat-head special screw. Insert a new 1/16 x ⅝ cotter pin through the protruding end of the special screw (fig. 35).

k. Secure each of two carriage flanges (fig. 35) to the plate assembly (fig. 34), using two ¼ x ½ fillister-head screws and two ¼-inch internal-teeth lock washers (fig. 35).

l. Place a ball bearing No. 8BC10PP on each of the two roller plates (fig. 39) and secure with a flat-fillister-head special screw (F).

m. Position each roller plate assembly (D) on the carriage plate (U) and secure in place with two flat-head screws (E).

n. Start a No. 5 x 1 1/16 flat-fillister-head special screw into one of the roller brackets (fig. 40). Place a plain washer on the special screw as it passes through the first flange of the roller bracket.

o. Place the two ball bearings No. 4BC03PP in the bracket.

p. Slide the special screw through the ball bearings (fig. 40). Slip another plain washer on the screw before it passes through the other flange of the roller bracket.

q. Push the special screw all the way through the bracket. Install a No. 5 internal-teeth lock washer (fig. 40) on the screw and tightly install a No. 5 hex nut, then tightly install a second No. 5 hex nut.

r. Assemble the other five roller assemblies (L) as in *m* through *q* above and secure each to the plate assembly (U, fig. 33 and fig. 34) with two fillister-head screws (M) and two ¼-inch internal-teeth lock washers (N).

65. Assembly of the Curved-Base Carriage

a. Insert the three No. 25BC02 ball bearings into the recesses of the bearing adapter (fig. 19).

b. Place the retainer (open center) over the center ball bearing and a disk over each of the other two ball bearings (fig. 19). Secure each disk and retainer with four No. 10 x ⅜ flat-head screws. Refer to paragraph 33 for procedure to change the sound-second setting.

c. Install the chamfered straight pins (L, fig. 37) used to locate the bearing adapter (M, fig. 37) on the carriage plate.

d. Place the adapter over the six drilled holes and the two pins in the center of the carriage plate (A, fig. 37), and secure with six fillister-head screws (G, fig. 37) and six ¼-inch internal-teeth lock washers (H, fig. 37).

e. Install and stake two carriage stops (fig. 36) on the carriage plate (one at each side).

f. The remaining components ((1) through (5) below) of the curved-base carriage are assembled in the same manner as their duplicates in the straight-base carriage, as given in (1) through (5) below.

(1) Two plates (par. 64*a*).
(2) Four 2½ long x 0.48 wide stop (par. 64*b*).
(3) Two plate brackets (par. 64*g* and *h*).
(4) Two carriage flanges (par. 64*k*).
(5) Four roller plate assemblies (par. 64*m*).

66. Assembly of Frame

a. Place the right and left time-difference scales in their grooves on the arc of the frame (fig. 32). Secure the scales to the frame with five 0.064 x $^{11}/_{64}$ straight pins. These pins are to be cut from a 7-inch length of aluminum-alloy, half-hard wire drawn to 0.064 of an inch.

b. Place the frame guide rail in position on the frame and secure it to the frame assembly (fig. 32) with eight ¼ x 1 fillister-head screws, eight ¼-inch internal-teeth lock washers, and eight ¼-inch hex nuts.

c. From the plunger bracket side of the frame, draw the two round-shoulder bushings (G, fig. 31) for the plunger bracket bolts into their holes in the frame, using a bushing puller.

Note. Position bushings so that shoulder sides are away from the plunger bracket.

With both bushings drawn firmly in position and using the chamfered straight pinholes as guides, drill a $\frac{3}{16}$-inch hole through the side of each bushing. Drive a $\frac{3}{16}$-inch chamfered straight pin into each hole to secure bushings in place.

d. Using a bushing puller, draw the two round-shoulder bushings (B, fig. 31), and one chamfered bushing (E, fig. 31) for the front cross rod into holes in frame. Tap with soft-faced hammer for complete fit.

e. Install the three frame bushings (C, fig. 31) in the 25-, 30-, and 35-second alternate sockets in the same manner described in steps *c* and *d* above, using a bushing puller. With bushings drawn in place and using the chamfered straight-pin holes in sockets as guides, drill a $\frac{3}{16}$-inch hole diagonally through the side of each bushing. Drive a $\frac{3}{16}$ x $\frac{5}{16}$ chamfered straight pin (D, fig.31) into each hole to secure bushing in place.

Note. Check with finger the protrusion of the straight pin within the inside diameter of bushings. Pin should not protrude, as this would interfere with the insertion of the pivot spindle.

f. Insert a round-shoulder bushing (H, fig. 31) inside each of the four frame leg sockets and start bushings in hex-head cap screw holes. Draw bushings into holes, using a bushing puller. The shoulder of each bushing inside the frame socket should be flush with inner surface of the frame socket before drilling hole for straight pin. When positioned, drill the $\frac{3}{16}$-inch pinhole, using hole of former straight pin as a guide. Secure bushing in place by driving a $\frac{3}{16}$-inch chamfered straight pin into each hole.

g. Insert each of the two $\frac{1}{2}$ x $2\frac{1}{8}$ clamping screws (fig. 14), narrow end first, in their recesses on the upper surface of the frame assembly. Install a wing knob onto the lower end of each clamping screw and drive a No. 4 x $\frac{5}{8}$ taper pin through each wing knob to secure knob and screw together.

67. Assembly of Legs and Brace

a. Screw the floor flange on each frame leg.

b. Slide the brace onto the four frame legs.

c. Install the four thumbscrews (fig. 29) in the four corner holes of the brace and tighten the thumbscrews.

68. Installation of Plotting-Board Frame on Legs

Place the frame assembly (fig. 28) on the legs and seat legs firmly in the leg sockets and secure with four ½ x 1 hex-head screws.

69. Installation of Straight-Base Carriage Assembly

a. Place the carriage assembly (fig. 45) on the frame assembly, making certain that the edge, which is drilled for the installation of the platen assembly, faces the plunger bracket (D, fig. 26).

b. Inspect the under side of the carriage assembly (fig. 34) to see that all rollers are correctly positioned on the frame. Compress the two roller arm springs so that the frame guide rail can be placed between the roller arm assemblies and the roller plate assemblies of the carriage. Allow the springs to push the roller of each roller arm assembly tightly against the rail.

c. Slide the carriage back and forth to check that the arm assemblies are holding the carriage firmly against the rail and that the carriage slides smoothly.

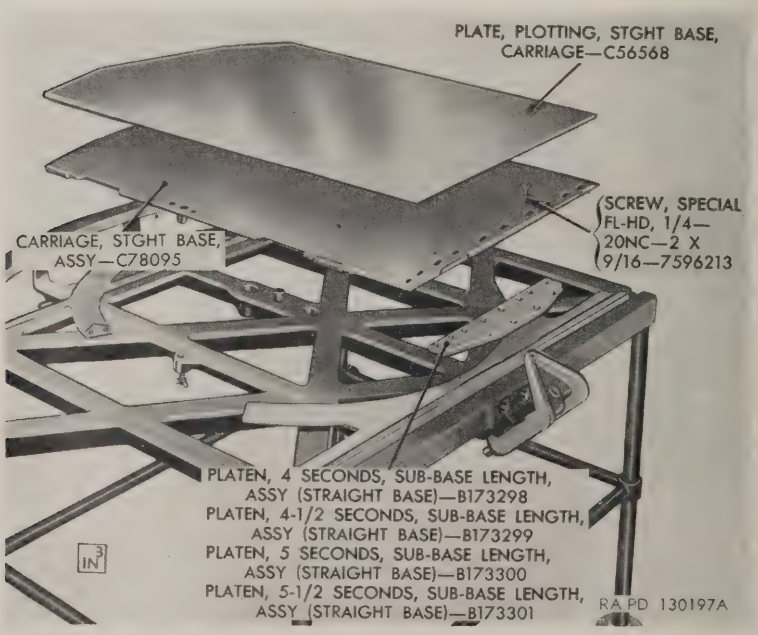


Figure 45. Straight-base plotting plate, carriage assembly, and platen assembly removed—sound-ranging plotting board M1 or M1A1.

70. Installation of Curved-Base Carriage Assembly

a. Place the carriage assembly (fig. 27) on the frame assembly, making certain that the edge, which is drilled for the installation of the platen assembly, faces the plunger bracket (D, fig. 26).

b. Inspect the under side of the carriage assembly to see that the desired socket in the adapter assembly (fig. 27) is centered over the pivot spindle properly, so that spindle will fit through the bearing adapter retainer without binding. Check that rollers are correctly positioned on the frame.

71. Installation of Platen

a. Place the platen assembly beneath the carriage assembly, at the end drilled for seven special screws (fig. 45).

b. Aline the screw holes by inserting the platen locating pins, on the under side of carriage assembly, into the platen (fig. 25).

c. Secure the platen to the carriage assembly (fig. 45) with seven $\frac{1}{4}$ x $\frac{9}{16}$ flat-head special screws.

d. Compress the rear tripping lever to lift the locating plunger and move the platen until a locating hole is directly beneath the plunger (fig. 12). Release the rear tripping lever.

72. Installation of Plotting Plate (Straight- or Curved-Base Carriage)

Position plotting plate over the carriage assembly and secure by tightening the special screw of each clamping plate assembly (fig. 18).

73. Installation of Microphone Center Assembly

a. Insert the microphone center assembly, pin end first, into the hole in the plunger bracket (fig. 22).

b. Aline the countersunk hole in the center assembly with the screw hole in the plunger bracket, then tightly install the No. 10 x $\frac{1}{4}$ cone-point headless set screw.

74. Installation of Asymptote Range Arm

a. Compress the clamping lever (fig. 21), slide the clamping mechanism support (fig. 43) over the frame assembly at any point on the arc of the time-difference scale.

b. Press the clamping lever (fig. 46) against the frame assembly until the clamping shoe assembly (D, fig. 42) is seated firmly against the bottom horizontal surface of the frame.

c. Release the clamping lever. Position the arm assembly to aline approximately with the plunger bracket.

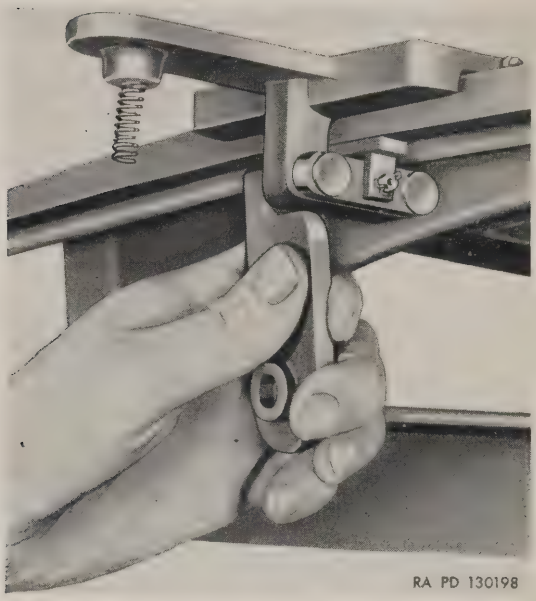


Figure 46. Seating the clamping shoe assembly—sound-ranging plotting board M1 or M1A1.

d. Working from the rear side of the board, carefully place the scale bearing over the microphone center assembly (fig. 10).

Section III. SOUND-RANGING WIND CORRECTOR M1

75. General

This section describes the removal, disassembly, inspection of component parts, repair and rebuild, assembly, and installation of the major assemblies of the sound-ranging wind corrector M1 (fig. 2). Lubrication instructions are contained in paragraph 28*h*.

76. Removal of Wind-Velocity-Scale Arm Assembly

a. Unstake, using a suitable chisel, and remove the pivot screw (fig. 8).

b. Loosen the clamping screw (fig. 47) and slide the arm away from the wind corrector.

77. Removal of Correction Scale (fig. 8)

The wind-velocity-scale arm assembly must be removed (par. 76) before the correction scale can be removed. Remove the two

flat-head screws and separate the correction scale from the correction-scale disk.

78. Removal of Azimuth Scale
(fig. 8)

The azimuth scale may be lifted free of the correction-scale disk when the correction scale and correction-scale disk have been separated (par. 77).

79. Disassembly of Wind-Velocity-Scale Arm
(fig. 47)

a. Unscrew and remove the two round-head screws that secure the scale to the arm and remove the scale.

b. Unscrew and remove the clamping screw. This action releases the clamp.

80. Disassembly of Correction Scale

The correction scale entails no disassembly after removal.

81. Disassembly of Azimuth Scale Assembly

Do not disassemble the azimuth scale.

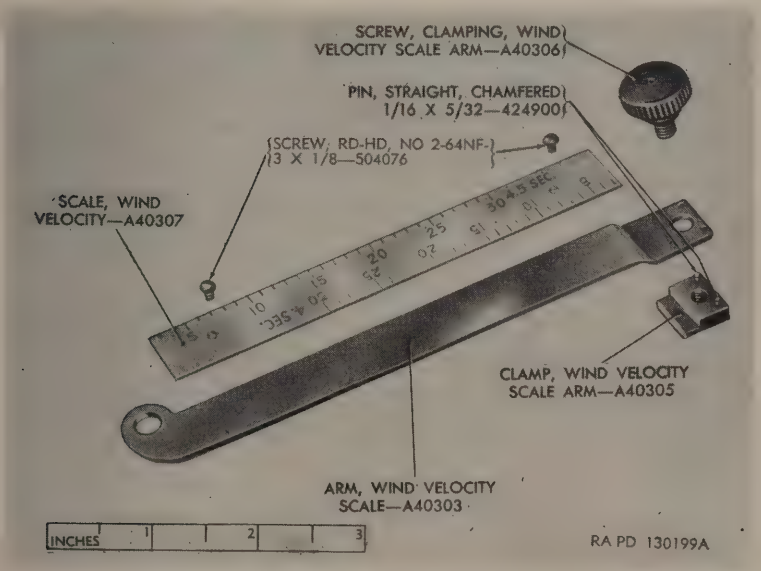


Figure 47. Components of the wind-velocity scale arm assembly—sound-ranging wind corrector M1.

82. Repair and Rebuild of Azimuth Scale Assembly

a. Replace any missing azimuth scale indexes (fig. 8) as directed in (1) through (4) below.

(1) Upset (peen over) the end of two $\frac{1}{16}$ x $\frac{5}{32}$ straight pins. This provides a rivet head on each pin to be inserted in the scale index slider. The holes in the slider are countersunk to receive the pin head.

(2) Slip the index slider with pins installed (head down) into the scale index groove of the azimuth scale.

(3) Insert the horizontal projection of a thin "L" shaped strip of hardened steel between the scale index slider and the floor of the index groove.

(4) Position the new scale index over the pins protruding from the index slider. The "L" shaped steel will serve as a backing plate while the ends of the pins are staked (by hammer and punch) to secure the index to the slider. Remove the "L" shaped strip of steel.

b. Tighten a loose scale index by using the "L" shaped strip of steel mentioned in (3) and (4) above.

c. Lubricate all parts as prescribed in paragraph 28*h*.

83. Rebuild of Correction Scale

Replace the correction scale if bent or otherwise damaged to such an extent that the wind-velocity-scale arm would bind while traversing the scale.

84. Repair and Rebuild of Wind-Velocity-Scale Arm Assembly

a. Remove burs from threads of clamping screw (fig. 47) and pivot screw (fig. 8).

b. Replace all worn or damaged parts.

c. Lubricate the pivot screw as prescribed in paragraph 28*h*.

85. Assembly of Wind-Velocity Scale Arm (fig. 47)

a. Secure the scale on the scale arm with two No. 2 x $\frac{1}{8}$ round-head screws.

Note. The screws must not protrude from the under surface of the arm. File down any protrusion of the screws to prevent scarring of the correction scale surfaces.

b. Place the arm clamp on the under side of the arm with the two protruding chamfered straight pins inserted in the pinholes in the end of the arm.

c. Secure the clamp to the arm with the clamping screw. Flare the end of the screw to prevent loss.

86. Installation of Azimuth Scale Assembly
(fig. 8)

Place the azimuth scale assembly on the correction-scale disk. The scale assembly must fit loosely to permit rotation.

87. Installation of Correction Scale
(fig. 8)

The correction scale is secured to the correction-scale disk over the azimuth scale assembly with two No. 5 x ¼ flat-head screws.

88. Installation of Wind-Velocity-Scale Arm Assembly
(fig. 8)

Place the arm assembly on the correction scale. Slip a plain washer under the pivot screw hole of the arm. Secure the arm to the correction-scale disk with the pivot screw and stake the screw.

Section IV. PLOTTING BOARDS M5 AND M5A2

89. General

This section describes the removal, disassembly, inspection of parts, repair and rebuild, assembly, and installation of the major assemblies of the plotting boards M5 and M5A2. Subassemblies are treated in logical order in relation to their major assemblies. Refer to paragraph 28 for lubricating instructions.

90. Test and Adjustment of Drafting Machine

Test the clearance between the range scale and the grid disk. Proper clearance is one thirty-second inch. Adjust by tightening or loosening the knurled-head adjusting screw (fig. 48) until the plotting scale is the desired distance from the plotting board.

91. Adjustment of Vernier

Adjust the vernier by rotating the frame until the central Y grid (one of the lines that cross at the center of the disk) coincides with the edge of the range scale. Loosen the two special screws on the vernier and shift the vernier until the "0" mark of the vernier is alined with the zero of the azimuth scale. Tighten the special screws (fig. 49). If it is impossible to obtain zero alinement, the grid disk must be adjusted. Loosen the six special screws (fig. 15) around the edge of the grid disk, shift the disk the required amount, and tighten the six screws. Refer to paragraph 93 for adjustment of parallelism of drafting machine.

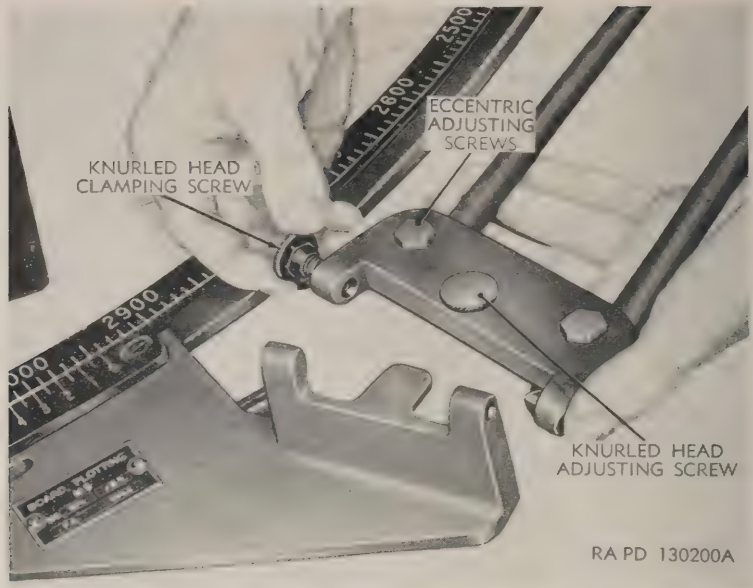


Figure 48. Installation or removal of the drafting machine—plotting board M5 or M5A2.

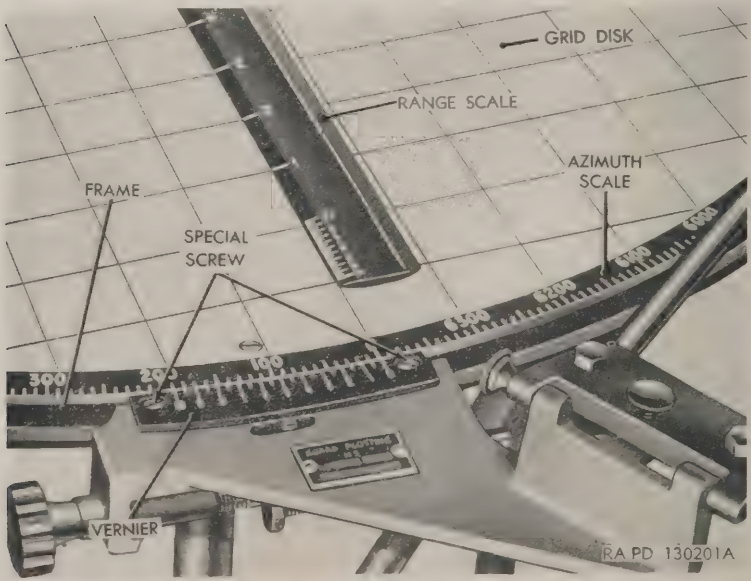


Figure 49. Vernier in adjusted position—plotting board M5 or M5A2.

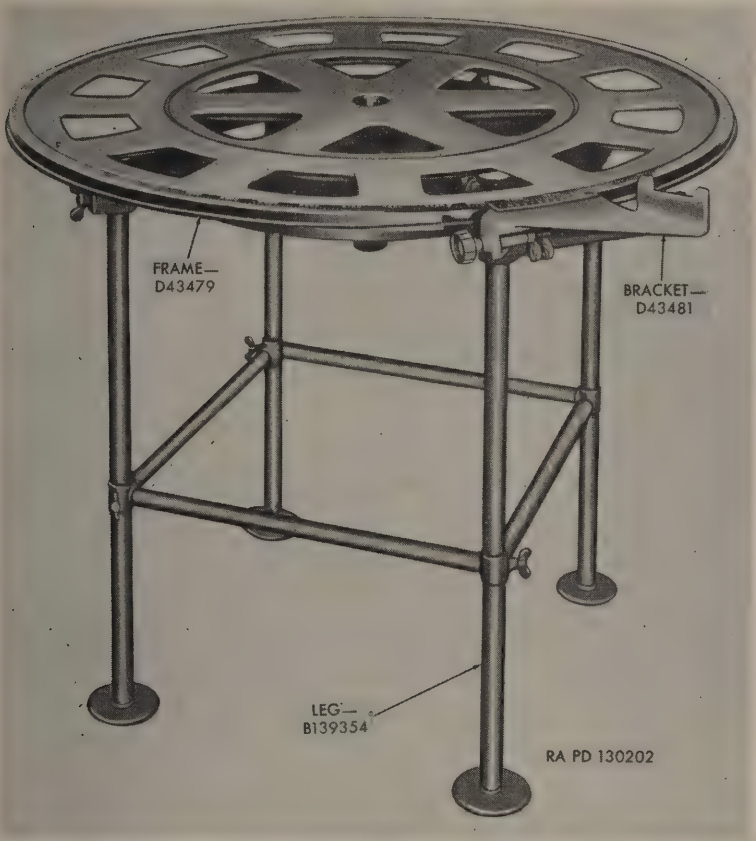


Figure 50. Drafting machine and grid disk removed—plotting board M5 or M5A2.

92. Adjustment of Spindle Nut

Adjust the round spindle nut when installing spindle (fig. 51) in center socket of support by tightening gently or loosening the nut until it fits snugly against the inner race of the radial ball bearing. Tighten the fillister-head screw to secure nut at proper adjustment. This adjustment is necessary so that ball bearing will not be taken up too tightly.

93. Adjustment of Parallelism of Drafting Machine

Adjustment of the vernier (par. 91) accomplishes the correct alinement of the range scale with the grid of the grid disk (fig. 49). However, if the alinement of the range scale with the grid lines varies as the scale is moved about on the plotting board,

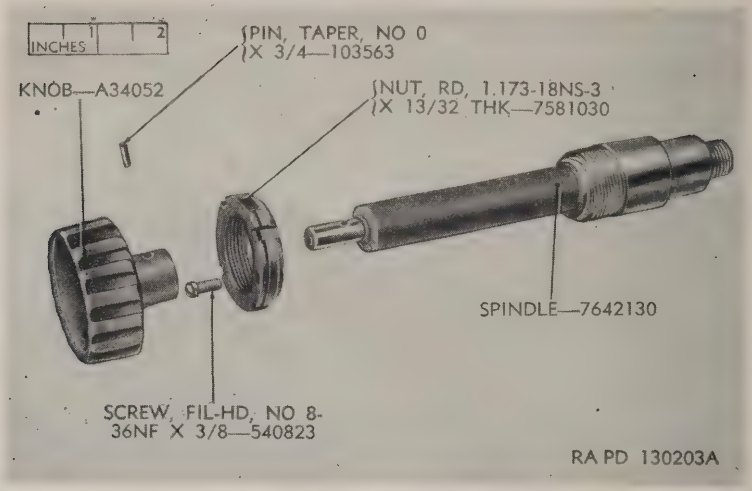


Figure 51. Components of the spindle assembly—plotting boards M5 and M5A2.

turn the two eccentric adjusting screws (fig. 48) in either direction, as required, to improve the parallelism of the drafting machine. The scale must remain parallel with the grid within 0.015 inch at any position on the disk. Any error is measured at one end of the scale while the other end is in coincidence with a grid line.

94. Removal of Drafting Machine

a. Loosen the knurled-head clamping screw (fig. 48) and nut of the clamping device that secures the machine to the bracket (fig. 50).

b. Swing the drafting machine away from the grid disk in a horizontal arc so that the machine pivots, until clear of the plotting board, on the cone-point studs of the clamping device.

95. Removal of Grid Disk, Spindle Assembly, and Frame

a. Remove the six flat-fillister-head special screws (fig. 15) that secure the grid disk to the frame. Remove the grid disk by pressing upward against the under side of the disk.

b. Unscrew and remove the spindle assembly from the flanged bushing (fig. 52).

c. Press the clamping lever (fig. 52) and carefully lift the frame from the support.

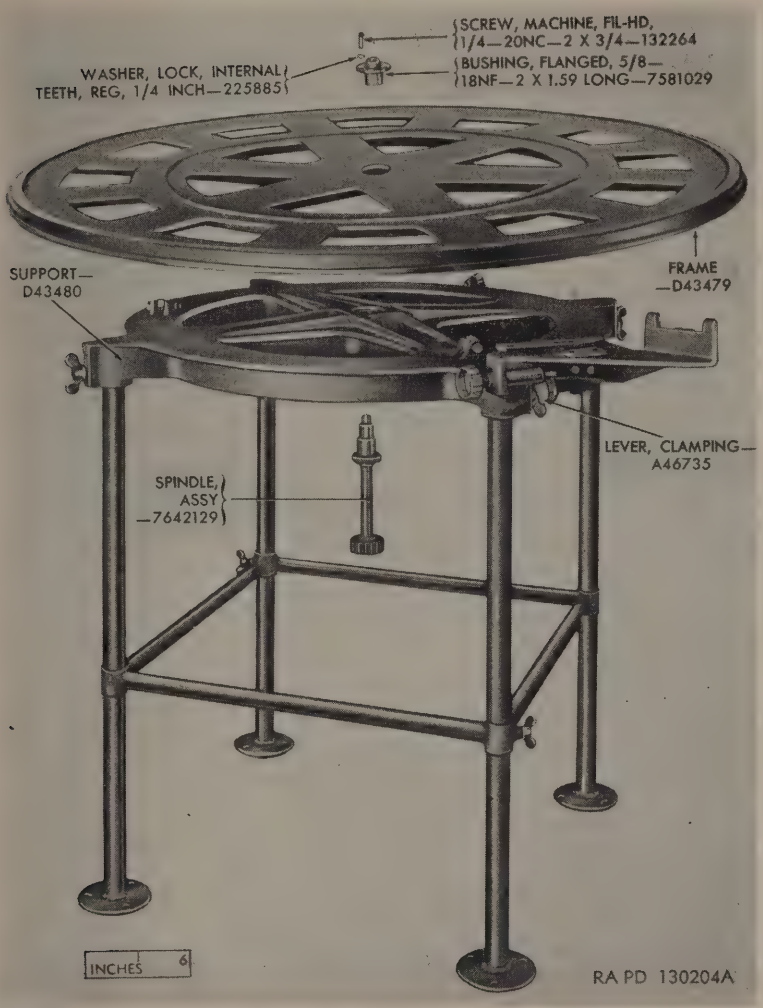


Figure 52. Removal of frame from support—plotting boards M5 and M5A2.

d. Unscrew and remove three fillister-head screws and lock washers that secure the flanged bushing to the frame. Remove the bushing (fig. 52).

96. Removal of Bracket

Remove the hex nuts and lock washers (fig. 53) from the two hex-head screws that secure the bracket to the support and withdraw the screws. Drive out the two pins that position the bracket on the support and lift off the bracket with associated parts.

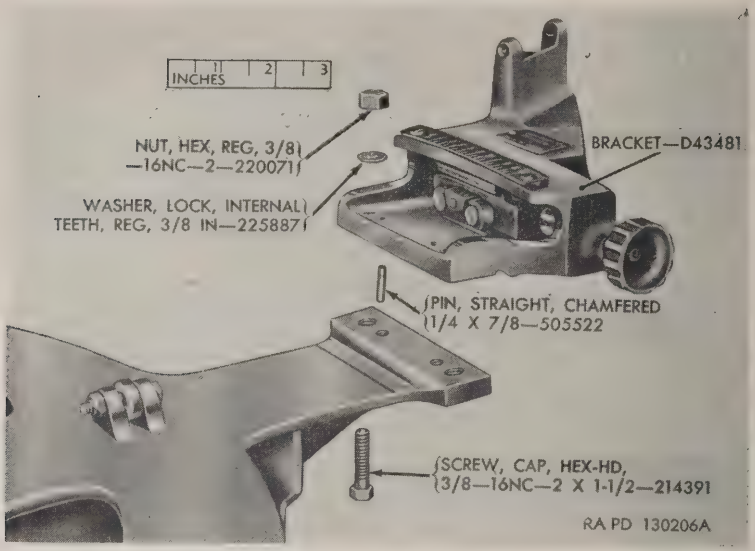


Figure 53. Removal of bracket from support—plotting board M5 or M5A2.

97. Removal of Support

a. Remove the headless special screw securing the thumbscrew and bushing at each of the four leg sockets on the under side of the support (fig. 54). Unscrew the thumbscrews, then lift the support from the legs.

b. Drive each of the bushings into the leg holes (fig. 55), then lift the bushing out.

98. Disassembly of Drafting Machine

a. Remove the two flat-head wood screws (fig. 56) that secure the drafting machine knob to the disk. Remove the knob.

b. Unscrew and remove the four flat-head screws that secure the knob disk to the range scale.

c. To separate the arms from the range scale, use the combination wrench 41–W–867–812 (table II and fig. 57) and unscrew and remove the ball-bearing lock nut and upper lock washer from the stud (fig. 56) of each arm.

d. Carefully lift off one arm at a time, while holding one hand under the arm end to avoid loss of any of the 12 ball bearings in each arm (fig. 58).

e. Remove the lower lock washer and withdraw the two studs from the range scale (fig. 56).

Note. Further disassembly of the drafting machine is unauthorized.

99. Disassembly of Spindle Assembly
(fig. 51)

a. Drive taper pin out of the spindle knob. Pull the knob from the end of the spindle.

b. Unscrew and remove the fillister-head screw from the round nut and unscrew the round nut from the spindle.

Figure 54. Removal of support—plottings boards M5 and M5A2.

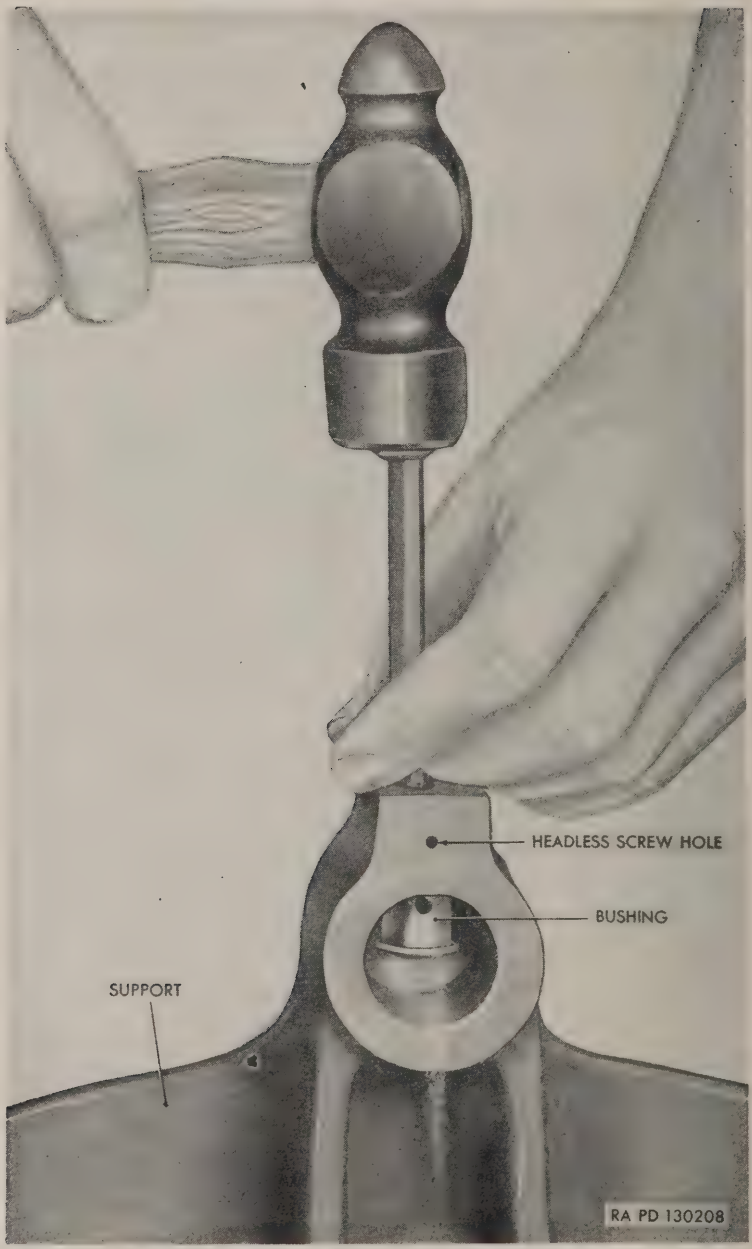


Figure 55. Driving bushing from leg socket of support—plotting boards M5 and M5A2.

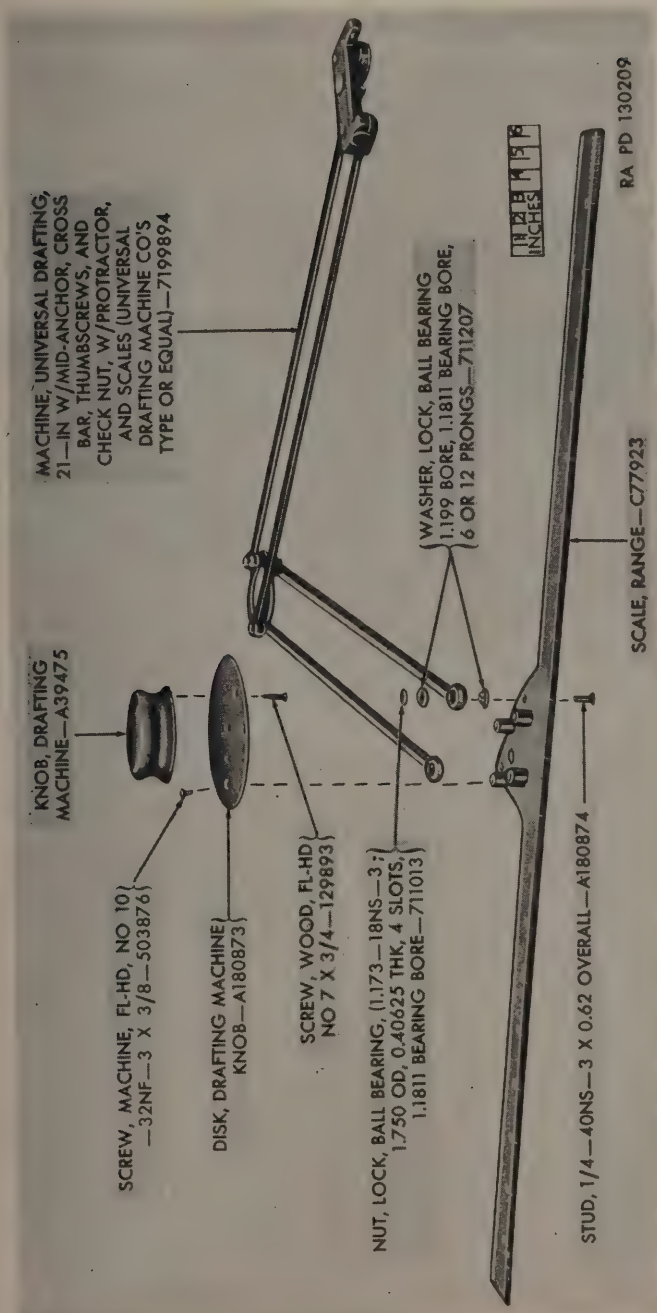


Figure 56. Components of the drafting machine—plotting boards M5 and M5A2 (M5 shown).

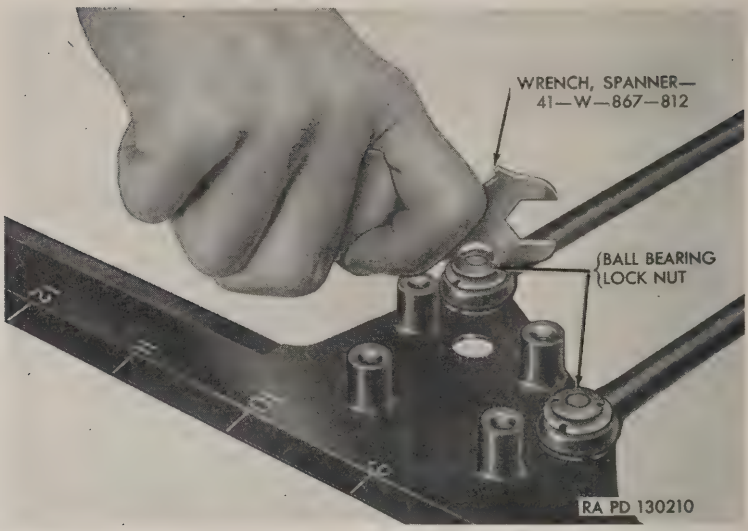


Figure 57. Removing ball bearing lock nut from stud of machine arm—plotting boards M5 and M5A2 (M5 shown).

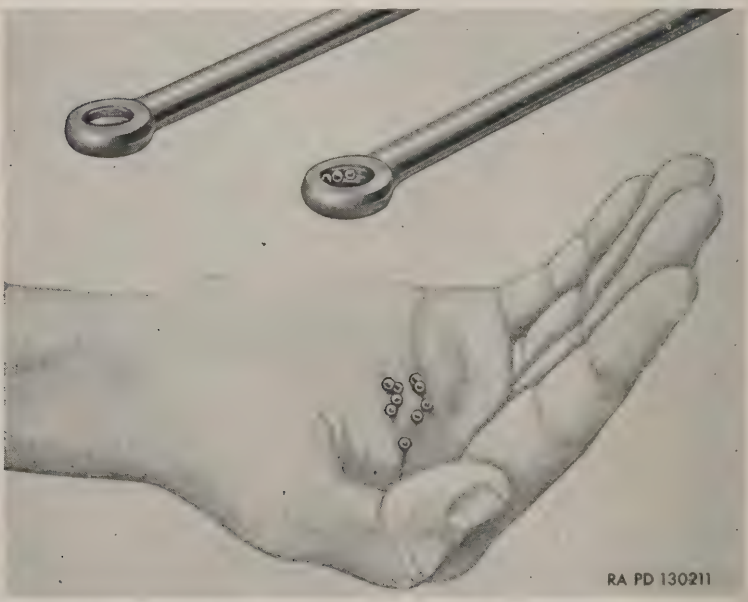


Figure 58. Removal of the ball bearings from the arm of the drafting machine —plotting boards M5 and M5A2.

100. Disassembly of Bracket With Component Parts

a. Drive out the taper pin that secures the collar to the lead screw assembly (fig. 59).

b. Unscrew the lead screw and remove it and the collar (fig. 60) from the bracket.

c. Drive out the taper pin that secures the knob to the lead screw and remove the knob.

d. Remove the two fillister-head special screws and the vernier (fig. 60).

e. Remove the headless special screw (fig. 61) that positions the slide in the bracket.

f. Remove the set screw (fig. 61) that secures the slide guide to the slide. Withdraw the guide from the bracket. This action releases the slide from the bracket.

g. Drive out the pin from the collar that secures the clamping pivot (fig. 62) to the slide. Remove the collar and pivot.

h. Drive out the taper pin that secures the clamping lever to the crank. Remove the lever and the compression spring.

i. Withdraw the crank from the slide and remove the clamping shoe.

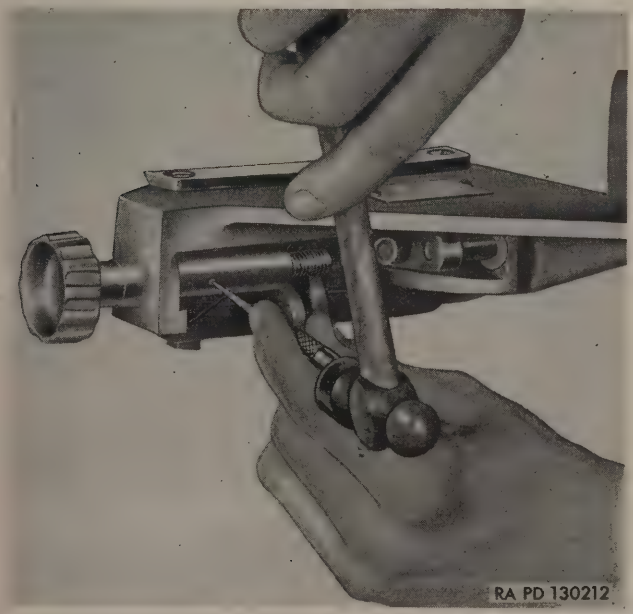


Figure 59. Removal of the lead screw assembly from the bracket—plotting boards M5 and M5A2.

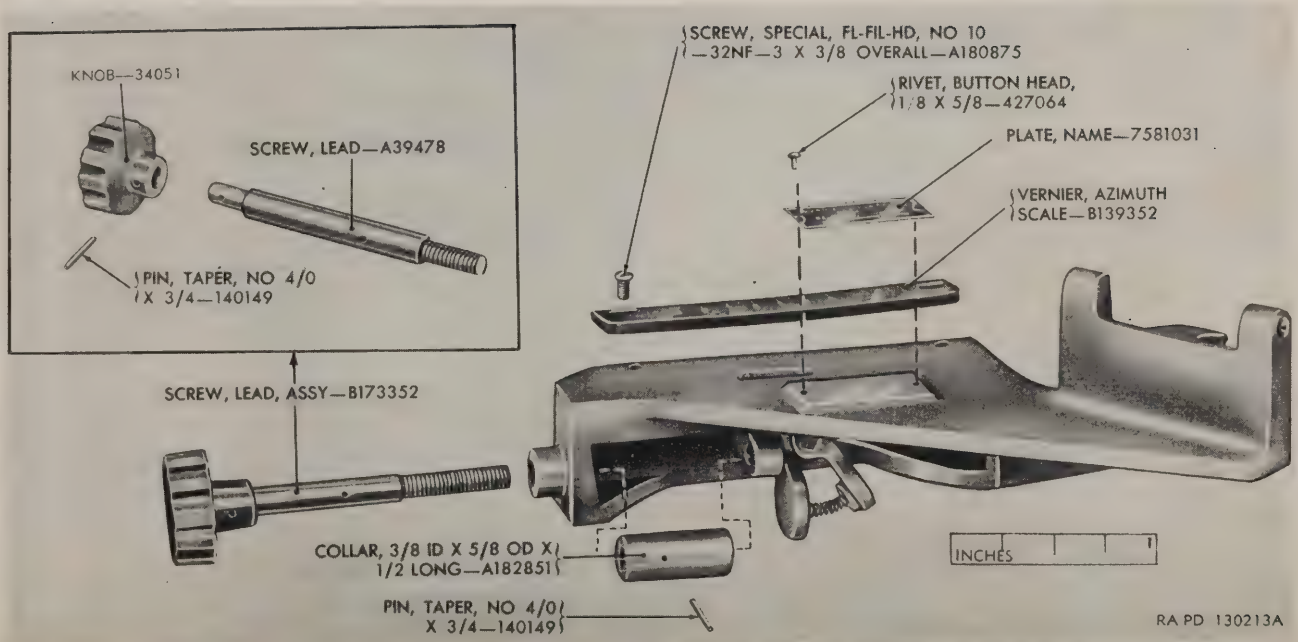


Figure 60. Components of the bracket—plotting boards M5 and M5A2 partially exploded.

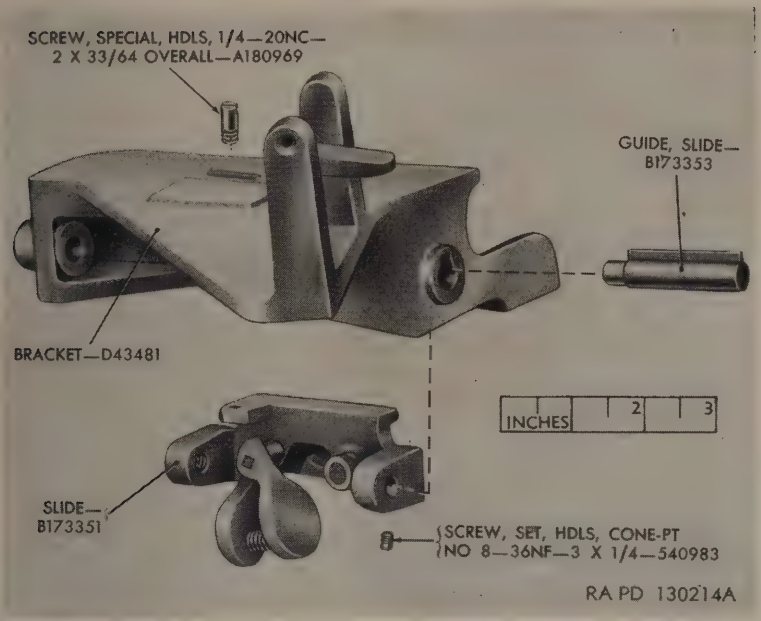


Figure 61. Removal of the slide from the bracket—plotting boards M5 and M5A2.

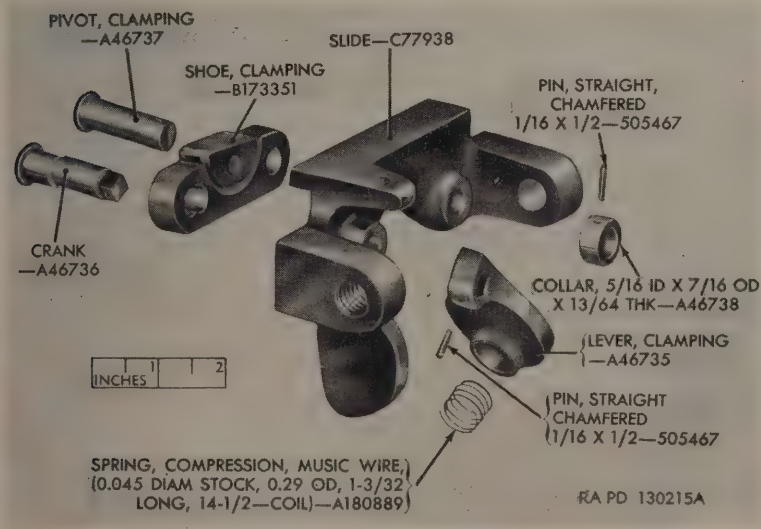


Figure 62. Components of the slide plotting board M5 or M5A2.

101. Removal of Bearings From Support

a. Unscrew the hex-head screw and safety nut (fig. 63) that secure each of the three ball bearings to the support. Withdraw the screw and remove the ball bearing.

b. If replacement is necessary, unstake and drive the radial ball bearing (for the spindle) from the center of the support (fig. 54).

102. Removal of Brace Assembly From Legs (fig. 64)

a. Unscrew and remove the four dog-point headless special screws that secure the four thumbscrews in the brace.

b. Remove the thumbscrews from the brace and withdraw the legs from the brace.

103. Repair and Rebuild of Legs

a. Remove burs from screws (par. 28*d*).

b. Replace worn or damaged parts.

c. Lubricate thumbscrews with aircraft instruments lubricating oil (par. 28*h*).

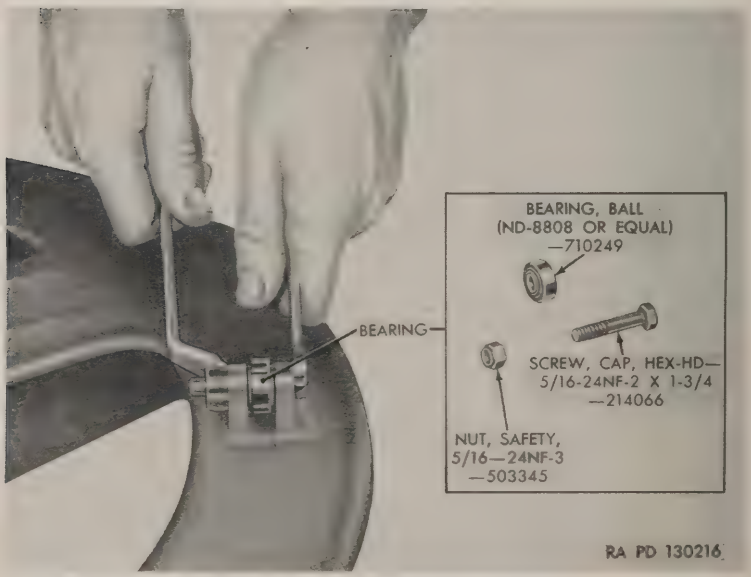


Figure 63. Removing ball bearing from support—plotting boards M5 and M5A2.

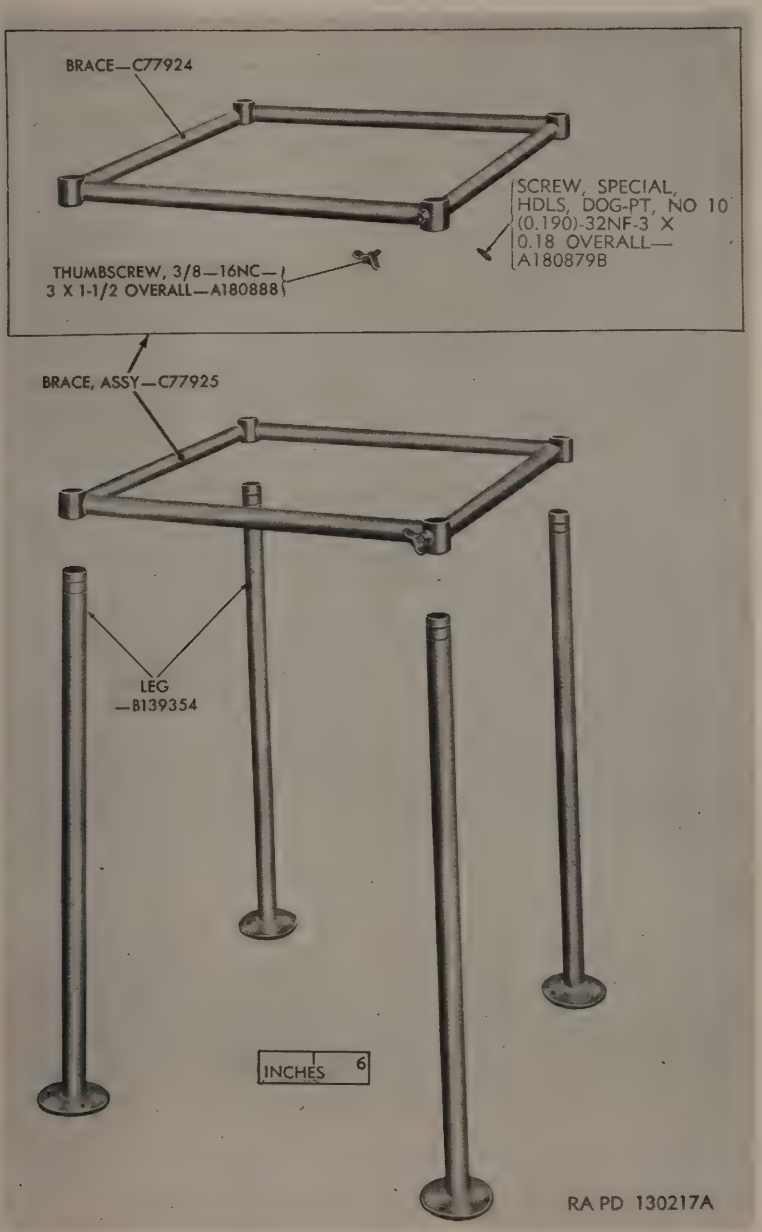


Figure 64. Brace assembly removed from the legs—plotting board M5 or M5A2.

104. Repair and Rebuild of Support

a. Remove burs from screws, bearings, and other surfaces (par. 28*d*).

b. Replace all worn or damaged parts.

c. Lubricate the inside of leg sockets of the support with aircraft and instruments lubricating grease (par. 28*h*).

105. Repair and Rebuild of Bracket

a. Remove burs from the lead screw and other metal surfaces (par. 28*d*).

b. Replace the vernier if cracked.

c. Replace worn or broken spring.

d. Replace all pins.

e. Replace all worn or damaged parts.

f. Lubricate all parts as prescribed in paragraph 28*h*.

106. Repair and Rebuild of Grid Disk, Spindle Assembly, and Frame

a. Remove rust from the frame (par. 28*e*). Replace badly damaged frame.

b. Remove burs from the spindle threads.

c. Replace cracked grid disk.

d. Lubricate all parts as prescribed in paragraph 28*h*.

107. Repair and Rebuild of Drafting Machine

a. Replace the drafting machine if any parts are damaged or missing as no replacement parts are authorized.

b. Refill illegible scale graduations (par. 28*c*).

c. Remove burs or corrosion from metal parts (par. 28*d* and *e*).

d. Lubricate all parts as prescribed in paragraph 28*h*.

108. Assembly of Drafting Machine (figs. 56 and 57)

a. Insert two studs into the stud holes in the range scale located near the bosses on the range scale (fig. 56). Use the combination wrench 41–W–867–812 (fig. 57) to install a ball-bearing lock washer on each stud.

b. Place the arms over the studs and install the 12 ball bearings into the recess formed by each lower lock washer and arm.

c. Using the combination wrench 41–W–867–812 (fig. 57), secure each arm to the range scale with one ball-bearing lock washer and ball bearing lock nut.

d. Place the knob disk in position over the four bosses of the range scale. Secure the disk to the scale with four No. 10 x $\frac{3}{8}$ flat-head screws.

e. To secure the knob disk, insert two No. 7 x 3/4 flat-head wood screws through the under side of the disk (fig. 56) and into the knob screw holes.

109. Assembly of Bracket With Component Parts

a. Place the clamping shoe against the slide with the shoe facing up. Insert the crank through the elongated hole of the shoe and into the slide (fig. 62).

b. Place the compression spring in its recess on the clamping lever. Slide the clamping lever over the square end of the crank. Secure the lever to the crank with a 1/16 x 1/2 chamfered straight pin.

c. Insert the clamping pivot through the clamping shoe and into the slide. Install the collar over the end of the clamping pivot and secure in place with a 1/16 x 1/2 chamfered straight pin.

d. Start the slide guide through the keyed slot of the bracket (fig. 61). Place the slide in position in the bracket and insert the slide guide into the slide. Then secure the guide to the slide with a No. 8 x 1/4 cone-point headless set screw.

e. Aline the screw hole in the upper surface of the slide with the slot in the bracket. Install the 1/4 x 33/64 headless special screw through the slot and screw it tightly into the slide.

f. Place the bronze knob on the unthreaded end of the lead screw assembly (fig. 60) and secure with a No. 4/0 x 3/4 taper pin.

g. Start the lead screw into the bracket. Hold the collar between the slide and the lead screw end. Continue turning the lead screw through the collar and into the slide until a taper pin can be inserted through the collar and into the lead screw. Then install the No. 4/0 x 3/4 taper pin.

h. Place the azimuth scale vernier in position on the bracket and secure with two No. 10 x 3/8 flat-fillister-head special screws.

110. Assembly of Support

a. If the radial ball bearing has been removed from the support because replacement is necessary (par. 101), place a new ball bearing (fig. 54) in the under side of the center socket of the support. Stake the bearing lightly at one spot. The bearing will be staked securely after the spindle assembly has been tested for fit in the frame. If the bearing is not properly alined with the spindle, the bearing must be positioned properly before final staking.

b. Install a ball bearing No. ND 88008 in each of the bearing mounting flanges on the support (fig. 63). Secure each of the three bearings with a 5/16 x 1 3/4 hex-head screw and a safety nut.

c. Install a bushing up through each of the leg holes, then press the bushing outward into the bushing recess.

Note. The flange on the bushing will be inner-most and the screw hole in the bushing and frame must aline. If a new bushing is used, it will be necessary to drill a new hole for the dog-point headless special screw (fig. 54) with a No. 21 drill.

111. Assembly of Legs and Brace Assembly (fig. 64)

a. Slide the brace on the legs until the brace is positioned at the thumbscrew depressions left from previous assembly.

b. Install the four thumbscrews into the brace. Tighten the thumbscrews.

112. Assembly of Spindle Assembly (fig. 51)

a. Slide the round nut on the spindle shaft and thread loosely.

b. Screw the No. 8 fillister-head screw into the round nut; do not tighten.

c. Place the knob on the spindle shaft and secure the knob to the shaft with a No. 0 x ¾ taper pin.

113. Installation of Support

a. Position the support on the four legs.

b. Tightly insert four thumbscrews in the support, one in each bushing at the leg position. Secure each of the thumbscrews to the support with a No. 10 dog-point headless special screw.

Note. If a new bushing has been installed, it will be necessary to drill the hole for the dog-point headless special screw (fig. 54) with a No. 21 drill.

114. Installation of Bracket

a. Install two ¼ x ⅞ chamfered straight pins in the bracket. Drive the pins until they protrude from the under side of the bracket.

b. Place the bracket in position on the support and drive the pins home.

c. Secure the bracket to the support with two ⅜ x 1½ hex-head screws, inserted through the support and into the bracket, two ⅜-inch regular internal-teeth lock washers, and two ⅜-inch hex nuts.

115. Installation of Grid Disk, Spindle Assembly, and Frame

a. Place the flanged bushing (⅝ ID x 1.59 long) in the recess of the upper surface of the frame (fig. 52). The bushing must fit

tightly or replacement is necessary. Secure the bushing with three ¼ x ¾ fillister-head screws.

b. Position the frame on the support.

c. Insert the spindle assembly through the lower side of the support, through the radial ball bearing in the center of the support, and tightly into the flanged bushing. The flanged bushing must be securely installed in the frame first, then the spindle assembly (with the round nut loosely installed) is installed tightly into the bushing. Now, the round nut (fig. 51) is carefully adjusted and tightened by the No. 8 x ⅜ screw on the round nut. For adjustment, see paragraph 92.

d. Position the grid disk over the frame. Aline the oval slots of the disk with the six screw holes of the frame. Secure the disk with six No. 10 x ⅜ flat-fillister-head special screws (fig. 15).

116. Installation of Drafting Machine
(fig. 48)

a. Insert the two cone-point studs of the clamping device in the outer sockets of the bracket.

b. Swing the drafting machine toward the grid disk until the clamping device is in position on the bracket. Secure the machine to the bracket with the knurled-head clamping screw and tighten nut finger tight.

CHAPTER 5

FINAL INSPECTION

117. General

Final inspection is performed after repair and rebuild has been completed to insure that the materiel is serviceable according to established serviceability standards.

118. Sound-Ranging Plotting Boards M1 and M1A1

a. General. The instrument is tested while assembled. Check the performance of the sound-ranging plotting board as detailed in paragraph 23*b*. Check the instrument for completeness and appearance. Painting and other finishes must give the instrument a new appearance. There must be no signs of rust.

b. Asymptote Range Arm Assembly.

(1) The arm scale will be flat and the beveled edge straight. The index wire will be stretched tightly in the index wire frame assembly.

(2) Check the microphone center point pin, the graduated beveled edge of the arm scale, and the index wire for alinement. They will lie in a straight line within 0.003 inch.

(3) The center point pin will be the center of curvature of the time-difference scales within 0.005 inch.

c. Straight-Base Carriage Assembly.

(1) The plotting plate will be flat and finely finished. There will be no scratches or other imperfections on the plotting surfaces.

(2) The carriage will be flat. Check the various roller assemblies. They must all touch the frame assembly.

(3) Attach a piece of paper to the plotting plate with masking tape. Set the arm assembly at zero on the time-difference scale. Establish a base line at approximately 18,000 yards by holding a sharp-pointed pencil against the paper while the carriage is moved over its entire range. Lock the carriage in position in one of the microphone station positions. With the arm assembly at zero on the time-difference scale, establish the microphone center point by depressing the microphone pin and drawing a line along the entire length of the graduated edge of the range scale. Repeat this procedure with the

carriage locked in the other station positions. The lines drawn must be parallel to each other and perpendicular to the base line. Extend each line to the microphone center point. The microphone center must now be exactly on the range line.

d. Curved-Base Carriage Assembly.

(1) Check condition of the plotting plate and carriage as in *c* (1) and (2) above.

(2) Attach a piece of paper to the plotting plate with masking tape. Set the arm scale at zero on the time-difference scale. Establish a curved-base line at approximately 18,000 yards by holding a sharp-pointed pencil against the paper while the carriage is rotated through its complete arc. Lock the arm in one of the microphone subbase positions. With the arm set at zero on the time-difference scale, establish one microphone center point by depressing the center point pin and drawing a line along the entire length of the graduated edge of the arm scale. Move the arm to 15 degrees on the left time-difference scale and draw a similar line extending the entire length of the arm scale. Repeat this procedure at 30, 45, and 60 degrees on the left time-difference scale. Repeat the entire process with the right time-difference scale. Release the plunger and move the arm to another microphone subbase position. Extend the lines drawn to the microphone center point. There must be no perceptible polygon of error. Repeat the entire procedure with at least three subbase positions. If there is the slightest trace of error, plot all five subbase lengths.

e. Frame Assembly.

(1) Test the front tripping lever by lifting it to its fullest extent. This action will lift the plunger of the plunger bracket out of the platen. There must be no slippage of the front tripping lever on the cross rod.

(2) The adjustable (rod end) yokes must be properly adjusted to provide adequate tension against the front tripping lever. Refer to paragraph 34 for adjustments.

(3) Check the pivot spindle; it must be screwed into the 30-sound-second (center) socket. The disks and the retainer must secure the three ball bearings in position.

f. Legs. The legs must be firmly secured to the frame. There must be no shimmy or looseness.

g. Test Problems. Each sound-ranging plotting board will be tested for functioning with the straight-base carriage and the curved-base carriage together with all the platens associated with

them. Functional performance will be checked by running the problems listed in table VI. No plotting board will be approved for issue to the field or return to storage after rebuild unless the error between the computed range and the measured range comes within the tolerance of ± 25 yards. Refer to TM 9–575 for operation of the sound-ranging plotting board.

119. Sound-Ranging Wind Corrector M1

a. General. Inspect the wind corrector for completeness and general appearance. The oxide finish must not have scratches deep enough to affect accuracy of the instrument. The instrument must be finished to give the appearance of a new wind corrector.

b. Azimuth Scale Arm Assembly.

(1) Scale graduations must be clear and distinct.

(2) The scale arm must be flat against the azimuth correction scale within one thirty-second inch.

(3) The fiducial edge of the wind-velocity arm and the axis of the pivot screw (fig. 8) must be in line with one another within one sixty-fourth inch.

c. Azimuth Scale Assembly. The azimuth scale assembly must fit snugly upon the surface of the correction scale disk, although a small amount of play is permissible. If the play exceeds one-sixteenth inch, the instrument is to be rejected. If indexes are loose or missing, repair or replace as in paragraph 82. The finish of the azimuth scale must not be pitted or otherwise damaged.

d. Correction Scale.

(1) The maximum allowable side play between the correction scale and the azimuth scale is 0.006 inch. If side play exceeds this maximum movement, the instrument must be declared unserviceable.

(2) Graduations must be legible. The surface of the correction scale must be free of foreign matter or paint spots.

120. Plotting Boards M5 and M5A2

a. General.

(1) Check for completeness and general appearance. The painted surfaces will not have bare spots, scratches that expose bare metal, or chipped or loose paint. The instrument will be finished to give the appearance of a new instrument.

(2) All headless screws will be concealed and secured with plugging cement.

(3) All graduations and numbers on the plotting disk, plotting scale, vernier, and azimuth scale will be clear and distinct.

Table VI. Sound-Ranging Plotting Board Test Problems

	Station No.	Time-difference scale (seconds)	Computed range (yards)	Measured range (yards)	Error (yards)
Straight-base—4.0-sound-seconds subbase.	1	−0.648	18,241		
	2	−0.327	18,061		
	3	0.000	18,000		
	4	+0.327	18,061		
	5	+0.648	18,241		
Straight-base—4.5-sound-seconds subbase.	1	−1.093	13,700		
	2	−0.558	13,395		
	3	0.000	13,291		
	4	+0.558	13,395		
	5	+1.093	13,700		
Straight-base—5.0-sound-seconds subbase.	1	−1.005	18,375		
	2	−0.511	18,094		
	3	0.000	18,000		
	4	+0.511	18,094		
	5	+1.005	18,375		
Straight-base—5.5-sound-seconds subbase.	1	−1.532	14,577		
	2	−0.789	14,146		
	3	0.000	14,000		
	4	+0.789	14,146		
	5	+1.532	14,577		
Curved-base—25-sound-seconds radius—4.0-sound-seconds subbase.	1	+0.459	14,297		
	2	+0.231	14,424		
	3	0.000	14,467		
	4	−0.231	14,424		
	5	−0.459	14,297		

	Station No.	Time-difference scale (seconds)	Computed range (yards)	Measured range (yards)	Error (yards)
Curved-base—25-sound-seconds radius—4.5-sound-seconds subbase.	1	+0.809	18,290		
	2	+0.406	18,513		
	3	0.000	18,588		
	4	−0.406	18,513		
	5	−0.809	18,290		
Curved-base—30-sound-seconds radius—4.0-sound-seconds subbase.	1	+2.582	6,068		
	2	+2.690	7,047		
	3	+2.722	8,049		
	4	+2.703	9,052		
	5	+2.648	10,041		
Curved-base—30-sound-seconds radius—4.5-sound-seconds subbase.	1	−1.667	5,167		
	2	−0.930	4,674		
	3	0.000	4,497		
	4	+0.930	4,674		
	5	+1.667	5,167		
Curved-base—30-sound-seconds radius—5.0-sound-seconds subbase.	1	−0.247	19,398		
	2	−0.602	19,242		
	3	−0.955	18,955		
	4	−1.298	18,540		
	5	−1.632	18,000		
Curved-base—35-sound-seconds radius—4.5-sound-seconds subbase.	1	−1.410	18,170		
	2	−1.586	17,617		
	3	−1.750	17,002		
	4	−1.906	16,326		
	5	−2.048	15,596		

Curved-base—35-sound-seconds radius—5.0-sound-seconds subbase.	1	+0.469	19,047		
	2	+0.236	19,176		
	3	0.000	19,221		
	4	−0.236	19,176		
	5	−0.469	19,047		
Curved-base—35-sound-seconds radius—5.5-sound-seconds subbase.	1	+1.696	18,000		
	2	+1.430	18,576		
	3	+1.151	19,052		
	4	+0.863	19,423		
	5	+0.568	19,687		

(4) Check the performance of the plotting board as detailed in paragraph 23*d*.

b. Drafting Machine.

(1) The plotting scale for the plotting board M5 will lie flat from the "5" to the "13" graduations when the "9" graduation is at the center of the grid disk. The plotting scale for the plotting board M5A2 will lie flat from the "5" to the "17" graduations when the "11" graduation is at the center of the grid disk. The ends of the range scale for both the M5 and M5A2 will be flat within one thirty-second inch.

(2) The beveled edge of the range scale will remain parallel to the grid lines within 0.015 inch at any position on the board. This test is to be performed while the grid disk is set to any cardinal point (0; 1,600; 3,200; or 4,800 mils). The error is to be measured at one end of the scale while the other end is in coincidence with the grid line.

c. Frame. The three rollers shall each be in contact with the frame at all times during the operation of the instrument.

d. Support. The spindle must screw securely into the frame bushing; the round nut (fig. 51) must fit against the under surface of the center ball bearing.

e. Test Problem. Functional performance of the plotting board M5 will be checked by performing the test problem shown in table VII. The coordinates of the observation posts and the azimuths of the observed flash are as follows:

Table VII. Plotting Board M5 Test Problem Information

Observation post	X Coordinate	Y Coordinate	Target azimuth from OP (mils)
OP 1	26,000	10,000	84
OP 2	22,300	8,400	511
OP 3	20,000	10,000	836
OP 4	21,300	13,700	1,167

These plotted lines should intersect at a point, the coordinates of which are: X =26,500; Y = 16,050. The range as measured from each observation post should be as follows:

OP 1 = 6,083 yards
OP 2 = 8,733 yards
OP 3 = 8,888 yards
OP 4 = 5,720 yards

If the ranges obtained from this test do not agree to within ±15 yards of the ranges obtained above, the plotting board should not be approved for issue to the field or return to storage. Refer to TM 9–575 for operation of plotting board M5.

APPENDIX

REFERENCES

1. Publication Indexes

Special Regulations in the 310–20 series; SR 110–1–1, ORD 1, and FM 21–8 should be consulted frequently for latest changes or revisions of references given in this appendix and for new publications relating to materiel covered in this manual:

2. Supply Manuals

The following manuals of the Department of the Army Supply Manual pertain to this materiel:

a. Destruction to Prevent Enemy Use.

Land Mines and Components; Demolition Explosives and Related Items; and Ammunition for Simulated Artillery, Booby Trap, Hand Grenade, and Land Mine Fire.	ORD 3 SNL R–7

b. Repair and Rebuild.

Cleaners, Preservatives, Lubricants, Recoil Fluids, Special Oils, and Related Maintenance Materials.	ORD 3 SNL K–1
Items of Soldering, Metallizing, Brazing, and Welding Materials; Gases and Related Items.	ORD 3 SNL K–2
Lubricating Equipment, Accessories, and Related Dispensers.	ORD (*) SNL K–3
Lubricating Fittings, Oil Filters, and Oil Filter Elements.	ORD 5 SNL H–16
Fire Control major items and major combinations for use with small arms, automatic guns, mortars, and field artillery.	ORD 3 SNL F–1
Miscellaneous Hardware	ORD 5 SNL H–2
Standard Hardware	ORD 5 SNL H–1
Tool Sets for Maintenance of Sighting and Fire Control Equipment.	ORD 6 SNL F–272

c. Sighting and Fire Control Equipment.

Board, Plotting, M5	ORD (*) SNL F–233

* See ORD 1 for published manuals of the ordnance section of the Department of the Army Supply Manual.

Board, Plotting, Sound Ranging, M1 . . . ORD (*) SNL F–154
Corrector, Wind, Sound Ranging, M1 . . . ORD (*) SNL F–153

3. Forms

The following forms pertain to this materiel:
DA Form 9–71, Locator and Inventory Control Card
DA Form 9–72, Ordnance Stock Record
DA Form 9–76, Request for Work Order
DA Form 9–77, Job Order Register
DA Form 9–78, Job Order
DA Form 9–79, Parts Requisition
DA Form 9–80, Job Order File
DA Form 9–81, Exchange Part or Unit Identification Tag
DA Form 446, Issue Slip
DA Form 447, Turn-in Slip
DA Form 468, Unsatisfactory Equipment Report
DA Form 811, Work Request and Job Order
DA Form 811–1, Work Request and Hand Receipt
DA Form 865, Work Order
DA Form 866, Consolidation of Parts
DA Form 867, Status of Modification Work Order
DD Form 6, Report of Damaged or Improper Shipment

4. Other Publications

The following publications contain information pertinent to this materiel and associated equipment :

a. Camouflage.
Camouflage, Basic Principles . . . . . FM 5–20

b. Decontamination.
Decontamination . . . . . TM 3–220
Defense Against Chemical Attack . . . . . FM 21–40

c. Destruction to Prevent Enemy Use.
Explosives and Demolitions . . . . . FM 5–25
Ordnance Service in the Field . . . . . FM 9–5

d. General.
Artillery Materiel and Associated Equipment . . . . TM 9–2300
Inspection of Ordnance Materiel in the Hands of Troops. TM 9–1100
Safety: Accident Reporting . . . . . SR 385–10–40
Supplies and Equipment: Unsatisfactory Equipment Report. SR 700–45–5

e. Operation.
Auxiliary Sighting and Fire Control Equipment. . TM 9–575

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